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CONTENTS.

PAGE

The Deer of the Peking Parks. By R. LYDEKKER. (*Illustrated*) 169

Vegetable Mimicry and Homomorphism.—IV. By Rev. ALEX. S. WILSON, M.A., B.Sc. (*Illustrated*) 171

The Plain of Prussia. By GRENVILLE A. J. COLE, M.R.I.A., F.G.S. 173

Distant Worlds. II.—A Review of some Recent Studies in Stellar Distribution. By C. EASTON. (*Illustrated*) 176

Jupiter's Great Red Spot and its Surroundings. By W. F. DENNING, F.R.A.S. (*Plate*) 178

Astronomy without a Telescope. XVI.—The Structure of Comets. By E. WALTER MAUNDER, F.R.A.S. (*Illustrated*) 180

Letters:

MARKINGS ON JUPITER. By W. F. DENNING. (*Illustrated*) 181

A MODERN TYCHO. By A. FF. GARRETT, LT. R.E. Note by E. WALTER MAUNDER 182

Notes 183

British Ornithological Notes. Conducted by W. P. PYCRAFT, A.L.S., F.Z.S., M.B.O.U. 183

Notices of Books 184

BOOKS RECEIVED 185

The Nobodies,—A Sea-faring Family.—IV. By Rev. T. R. R STEBBING, M.A., F.R.S., V.P.L.S., F.Z.S. (*Illustrated*) 185

Microscopy. Conducted by M. I. CROSS. 189

Notes on Comets and Meteors. By W. F. DENNING, F.R.A.S. 190

The Face of the Sky for August. By W. SHACKLETON, F.R.A.S. 191

Chess Column By C. D. LOCOCK, B.A. 191

THE DEER OF THE PEKING PARKS.

By R. LYDEKKER.

OCTOBER 12th, 1860, will always be memorable as the date of the burning of the Imperial "Summer Palace" in the Yuangming Yuan, the wonderful pleasaunce situated to the north-west of Peking. The Yuangming, which had apparently been hitherto unvisited by Europeans, occupies an area of many hundred acres, and is in fact a park diversified with lakes, and containing a collection of buildings of immense extent, among which was the Summer Palace. The most beautiful part is the forest clothing the flanks of the Hiang-chan hills, which attain a height of a thousand feet, and from which may be viewed at the foot the extensive lake, and in the far distance the walls of Peking enveloped in a smoky haze. Dotted through the gardens were temples, lodges, and pagodas, groves, grottos, lakes, bridges, terraces, and artificial hills. "It certainly was," writes a spectator, "one of the most beautiful scenes I had ever beheld." In the Summer Palace were gathered together all the treasures and curiosities accumulated by the reigning dynasties of China during untold centuries. All these perished in the conflagration, which lasted two days. Whether this burning of the palace, which was ordered by Lord Elgin as a punishment for the atrocities inflicted by the Chinese on British subjects, was justifiable, is not

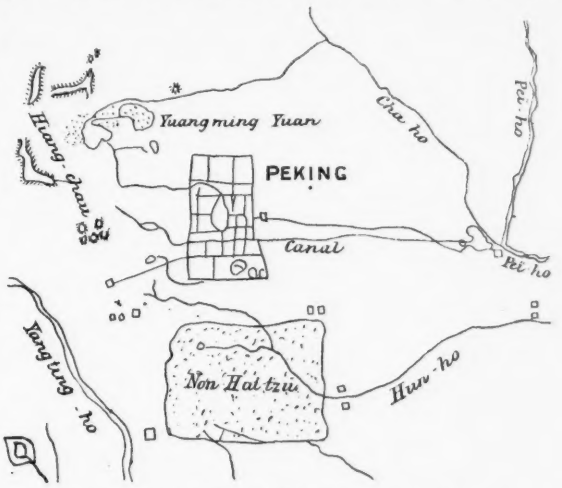


FIG. 1.—Sketch Map of Peking and its Environs.

our province to enquire—Mr. Justin McCarthy, in his "History of Our Own Times," considers that it was.

All that concerns here is the fact that among the *loot* sent home from the destruction of the Yuangming Yuan were the skins and antlers of certain deer which had been shot in the gardens. These specimens, now in the British Museum, appear to have been obtained by Colonel Saul, although Consul Swinhoe was the gentleman by whom they were sent to this country.

Although there does not appear to be any record that such was the case, these specimens may be taken as an indication that among the other attractions of the grounds of the Summer Palace were herds of deer, kept either for the purposes of sport or to enhance the beauty of the landscape. The best of the three specimens sent home was a young stag in the winter coat, of which a coloured figure was given in the *Proceedings* of the Zoological Society of London for 1861. By the late Dr. Gray, then Keeper of the Zoological Department of the British Museum, this deer was regarded as belonging to an ill-defined species named many years before. Two years later this identification was disputed by Mr. Swinhoe, by whom the specimen was regarded as representing a new species, for which the name *Cervus hortulorum*—the deer of the [Summer Palace] Gardens—was, appropriately enough, suggested.

For many years this species was regarded as inseparable from one inhabiting Manchuria, which is now known to be a very different animal. But among the deer now living in the Duke of Bedford's park at Woburn are a herd of a very beautiful species from Northern Manchuria, which has been proved identical with Mr. Swinhoe's *Cervus hortulorum*. These Peking deer (as it has now been agreed to call the species) are remarkable for the extraordinary difference between their summer and winter dress—a difference so great that persons who have seen them at one season may well be excused for not recognizing them at the other. In the summer coat, as shown in Fig. 2, they are of a brilliant reddish chestnut,

XUM

profusely spotted with white; in winter, on the other hand, when the coat of the old stags becomes very long and shaggy, they are uniformly umber-brown, although traces of spots may persist in the younger stags and hinds. The old stags are but little inferior in size to

FIG. 2.—Peking Stag in Summer Dress, with the Antlers in Velvet.
Photographed by the DUCHESS OF BEDFORD.

red deer, with which species certain hinds from the Summer Palace were indeed identified by Mr. Swinhoe, who quite failed to recognize that they were really the adult form of his "garden deer."

In England the Peking deer seems to thrive as well as red or fallow deer, and in time we may hope to see it established in many of our parks.

But the Yuangming Yuan was not the only park where deer were kept by the Chinese Emperors. To the south of Peking, as shown in the accompanying sketch-map, lies a park known as the Non Hai-tzu (or Nanhai-tze), far exceeding in extent the Yuangming Yuan, the brick wall by which it is enclosed being forty-five miles in circuit. This imperial hunting-park, as it is commonly called by Englishmen, is separated from the city by a plain, which is marshy in places, and gives rise to a river, flowing in part of its course through the park itself. The whole tract is thickly forested, but villages and military posts are dotted here and there in the clearings.

The park was in former days strictly guarded, and no Europeans were allowed entrance, although there are reports that by the aid of disguises a few entered from time to time. According to rumour, the park was the home of large herds of deer of various kinds, as well as of flocks of the Mongolian gazelle, or yellow sheep, as it is called by the Chinese.

Till the year 1865 naturalists had no idea as to the species of deer to be found in the Non Hai-tzu, the Anglo-French expedition of 1860 having confined their attention to Peking and the Yuangming Yuan. In February of the former year, however, the well-known French missionary, explorer, and naturalist, Père Armand David, obtained an opportunity of looking over the wall, and was much astonished at the sight which met his eyes. In addition to Mongolian gazelles, he saw herds of a species of deer which he then regarded as an unknown kind of reindeer, although he described it as somewhat donkey-like in appearance, with a long well-haired tail. At that season of the year the stags were without antlers. At the time the energetic missionary was quite unable to obtain a specimen of the new deer, but by bribing the Tatar guards of the park he succeeded in January of the following year in acquiring the skins of a stag and hind. Meantime the French Minister at Peking had been endeavouring to procure a living pair of this deer by diplomatic means, and in February of that year succeeded in his efforts. The stag, however, unfortunately died soon after its removal from the park, and its skin was sent to Paris with those of the two specimens obtained from the Tatar guards.

When these specimens arrived at the Paris Museum they were examined by Prof. Milne-Edwards, who in due course described them as representing a new genus and species of deer, under the name of *Elaphurus davidianus*. By the Chinese, it may be well to mention, the animal is known by the name of Mi-lou, or, more commonly, Ssen-pou-siang.

The accompanying photograph (Fig. 3) gives an excellent idea of the external appearance of the stags of this very remarkable and interesting species of deer. To describe its

FIG. 3.—Père David's Mi-lou Stag.
Photographed by the DUCHESS OF BEDFORD.

characteristics in anything like detail would obviously be quite out of place in an article of the present nature, and it will suffice to allude to a few of its more striking peculiarities. One feature by which the stags of this species differ from those of all other Old World deer, save the elk and the roe, is that the antlers are of the forked type. That is to say, in place of having a forwardly projecting brow-tine immediately above their base, the main

shaft, or beam, is undivided for a short distance, and then splits in a fork-like manner. A peculiarity of the mi-lou deer, and one whereby it differs from all the numerous species of American deer carrying antlers of the forked type, is that the hind prong of the main fork forms an undivided tine of great length directed backwards. The front prong, on the other hand, is forked at least once, and has but little forward inclination till the point of bifurcation is reached. The long donkey-like tail, which attracted the attention of the Abbé David at his first sight of the animal, is particularly well displayed in the photograph. The general colour of the coat is fawn-grey, becoming lighter on the face, rump, inner sides of the limbs, and under-parts. Unlike the majority of deer, there is but little change in the colour of the coat according to season. One very curious peculiarity displayed by the stags in the herd of mi-lou deer at Woburn Abbey is that they shed and renew their antlers twice a year, instead of once, as in other deer. Whether, however, this peculiarity has always been inherent in the species, or whether it is the result of long domestication, is impossible to say, for the species is quite unknown in a wild state. Indeed it cannot now be ascertained whether this double change of antlers took place among the herds in the Non Hai-tzu, or even in the specimens first brought to Europe.

The date of the introduction of these deer into the imperial hunting-park is probably very remote, seeing that, as already said, they have never been found wild in any part of Asia by Europeans. It is true that, according to Dr. S. W. Bushell, to whose account reference is again made in the sequel, a Chinese writer of the latter part of the eighteenth century mentions Kashgaria as the native country of these deer; but even if that be correct, the species may have been exterminated there centuries ago. Anyway, there is but little hope of its survival in that district at the present day.

As China became slowly opened up to European enterprise, the difficulty of obtaining specimens of the mi-lou deer gradually decreased, and in August, 1869, a male and female were received at the menagerie of the Zoological Society as a gift from Sir Rutherford Alcock. A second pair were acquired by purchase in 1883, since the death of which the species appears to have been unrepresented in the Society's collection. Meanwhile specimens were from time to time received by various menageries on the Continent; and the species has bred at the gardens of the Société d'Acclimatation at Paris and elsewhere.

The subsequent history of this interesting and remarkable species is extremely sad, no one apparently having had the least idea that it was on the point of extermination until too late. No definite statements are made by the earlier travellers as to the numbers of these deer in the Non Hai-tzu when they first came under the observation of Europeans. Writing, however, in the summer of 1898 to the secretary of the Zoological Society, Dr. Bushell stated that he had formerly ridden among the herds which swarmed in the imperial park, where they appear to have been reserved for the sport of the Court, and were carefully protected. Whether, in later years, less care was taken than formerly to see that the park and its surrounding wall were in good condition, the account does not state; but during or about the year 1894 the Hun-ho, which flows through the park, became flooded, and breached the wall in several places Through the gaps thus made all the mi-lou deer escaped, and appear to have been killed and eaten by the peasantry of the surrounding districts, who were suffering at that time from famine. In his letter Dr. Bushell promised to make enquiries on his return to China if any of the deer had escaped destruction, but as nothing more has been heard from him on the subject, it may be presumed that all were slaughtered.

Assuming, then, that the mi-lou deer does not exist in a wild state in some unexplored part of Kashgaria, or other remote part of Central Asia, it seems only too evident that its sole living representatives are those preserved in European collections. By far the greater number of these are now at Woburn Abbey, where they run in the open park with the other deer. They breed freely, without an undue proportion of males among the fawns; a very hopeful sign being, that some hinds purchased from Paris, where they were sterile, bred after they were transferred to their new quarters. Some time ago the herd at Woburn numbered over twenty head, and it has probably increased since that date. One point in favour of the prospects of the survival of the Woburn herd is the fact that the species has for centuries been kept in a state of semi-domestication, that is to say, it has lived in an enclosed park without, apparently, any infusion of fresh blood. It would, therefore, seem probable that it will be less likely to suffer from the effects of inbreeding than is the case with animals suddenly transferred from the wild state to captivity. Every care is, of course, taken of these valuable animals, and naturalists will watch with interest the results of the attempt to renew and preserve a decadent and almost exterminated race.

So far as I am aware, Père David's mi-lou deer is the only example of a mammalian species used neither as a food-supply or as a beast of burden which has been preserved from extermination in a semi-domesticated state.

Readers of this article who may be desirous of seeing the mi-lou deer, will find a handsome stag, with fully developed antlers, exhibited in the Natural History Museum, where there is also the mounted head of a female—both the gift of the Duke and Duchess of Bedford. Unfortunately, the taxidermist to whom the task of mounting the stag was confided (and taxidermists are the despair of naturalists, whose name they are prone to appropriate!) took for his model a red deer instead of photographs like the one here reproduced. Consequently, instead of having the slouching, donkey-like carriage so essentially characteristic of the species, the Museum specimen is represented with its head elevated, after the fashion of Landseer's picture "The Monarch of the Glen."

As already mentioned, the mi-lou deer, which is the sole representative of its kind, has no near relatives in the Old World. In spite of a certain not very important difference in the structure of the bones of the fore-foot, it appears, however, to be a not very distant cousin of the typical American deer, that is to say, the numerous species other than the elk, the wapiti, and the reindeer, which are really Old World forms, whose entrance into America is probably a comparatively recent event. Probably both the mi-lou and the American deer are the descendants of an extinct group, with antlers of the same general type, which flourished in Europe during the later portion of the Tertiary epoch. The greater the pity that such an ancient and remarkable type as the former should be on the point of extermination!

VEGETABLE MIMICRY AND HOMOMORPHISM.—IV.

By Rev. Alex. S. Wilson, M.A., B.Sc.

The Fungi are an exceedingly numerous class, exhibiting extraordinary diversity of shape and colouring; many remarkable resemblances are observed among them, but the life-history in several groups is imperfectly known

so that the significance of the analogous characters is in many cases still problematical. Odd resemblances to various objects, which can only be regarded as accidental coincidences, are presented by a number of fungi. There is the Jew's-ear fungus, which grows on stumps of the elder, and is so named from its unmistakable likeness to a human ear. The Geasters are curiously like star-

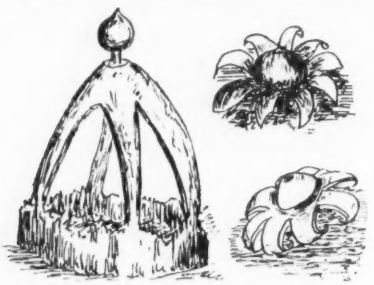


FIG. 16.—Geasters.

fish; Aseröe has an extraordinary resemblance both in form and colour to a sea-anemone; equally remarkable is the likeness to a bird's nest seen in species of Crucibulum, Cyathus and Nidularia. Though most of these are too small to impose on one the resemblance is singularly exact, and a large specimen might almost pass

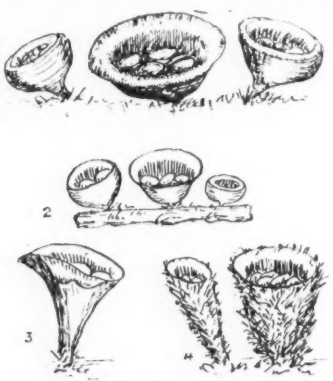


FIG. 17.—Bird's-nest Fungi. 1, Crucibulum. 2, Nidularia. 3 and 4, Cyathus.

for the nest of some small bird, the eggs being admirably represented by the little oval fruits of the fungus.

Even in such cases we must not too rashly conclude that the resemblance confers no advantage. The existence of attractive characters in so many fungi points to the conclusion that the same principles are in operation among them as among flowering plants. Numerous facts indicate a tendency in fungi to assume a guise which helps either to protect the plant or to promote the fertilisation, germination or dispersion of its spores. If, as some mycologists believe, spores benefit through being swallowed by animals, it is easy to understand how a fungus might profit by being mistaken even for a bird's nest containing eggs.

A similar explanation readily suggests itself of the likenesses seen in *Tremella moriformis* and *Licea fragiformis*; as their names indicate the former resembles a mulberry, the latter a ripe strawberry. In his paper on "Mimicry in Fungi," Dr. Plowright (Grevillea, Vol. X.) instances species which present a likeness to the ear of a rabbit or hare, to the liver, brains and entrails of animals, to honeycomb, to tangled horse hair, and in a number of others to the excrement of various animals.

Most toadstools appear to be coloured in strict accordance with the principle of the protective resemblance. Even for an experienced observer it is impossible to distinguish a fading leaf as it lies in the grass in certain positions from the yellow pileus of an agaric. Protective colouring is also well seen among the Pezizas, many of which are clad in obscure tints. Dr. M. C. Cooke (Grevillea, Vol. IX.) has described several species which grow on charcoal or on charred ground and are easily overlooked on account of their resemblance to the blackened soil. One agaric grows on clay, which it closely resembles in colour, several grow among dead pine leaves and are easily mistaken for old pine-cones. Other instances are *Ag. sordidus* on dung-hills, *Ag. fusipes* on rotten wood, *Ag. vertirugis* among dead bracken, species of Mycena among dead leaves and twigs, and Paxillus on sawdust. One or two agarics grow among grass and have a green colour corresponding to their environment. The conical caps of *Ag. hypnorum* resemble the calyptra of the mosses among which they grow, while most of the brighter coloured agarics harmonize very well with the bright tints of freshly fallen autumnal leaves. In striking contrast to the gay tints of the fly agaric is the snowy whiteness of its near ally *Amanita nivalis*, an alpine fungus growing on our loftiest mountains.

Besides the scarlet amanita mimicked as we have seen by Balanophora, other attractively coloured fungi are

FIG. 18.—The Scarlet Amanita.

the red Peziza cup, Cordiceps and Cortinarius, the coral-like Anthina, the crimson Russula, the amethyst agaric and Clavaria, the violet Marasmius, the purple Russula, the green Boletus, several bright yellow agarics and the black Geoglossum. A number of fungi are phosphorescent; some tropical species light up the jungle at night; others occur in coal mines. Several Polypori growing on dead wood become luminous in the dark.

The odours of fungi are very varied. Clathrus and Phallus are offensive and attract swarms of blow-flies, Lactarius and Hydnum, on the other hand, are sweetly scented like the flowers of Melilotus. Among the odours of fungi enumerated by Dr. Plowright are those of aniseed, mint, peppermint, garlic, horse-radish, cucumber, ripe apricots, rotting pears, rancid herring, Russia leather, gas tar, prussic acid, nitric acid and cacodyle. Like the hemlock, *Agaricus incanus* has the smell of mice, two species of Lactarius have the odour of the

common house-bug, while *Hygrophorus cossus* smells like the larvæ of the goat-moth. Fifteen or sixteen species of agaric resemble oatmeal both in taste and smell; *Hydnum repandum* has the flavour of oysters, recalling the oyster plant among the Boraginaceæ, whose leaves have a similar taste. Several are possessed of a nut-like flavour.

The common Stinkhorn, *Phallus impudicus*, is the best known representative of a large family of fungi, the members of which are found in various parts of the

Fig. 19.—The Stinkhorn.

Fig. 20.—Clathrus.

world. The Phalloidi include Phallus, Lysurus, Simblum, Clathrus, Aserõe and other genera, all characterized by offensive odours and conspicuous colours. These fungi have been carefully studied by Mr. T. Wemyss Fulton, whose paper on the "Dispersion of Spores in Fungi" in the *Annals of Botany* for 1899 contains many interesting and important observations bearing on mimicry.

The rapid elongation of the stinkhorn is very remarkable; the fungus has been observed to attain a height of several inches in half an hour, furnishing an apt illustration of the proverb that ill weeds grow apace. It not only emits an intolerable charnel-house stench, but its ghastly pallid hue seen against the background of its usual surroundings is peculiarly suggestive of the dead carcass of some animal. Its surface at first exudes a sweetish slime containing sugar, but the hymenium or spore-bearing portion is deliquescent and the entire mass speedily undergoes a series of changes, the white becoming brown, then black, the solid mass being ultimately resolved into a dark fœtid fluid in which the spores are suspended. These mimetic changes, which so closely approximate to those of decomposition, attract carrion flies in prodigious numbers. Blow-flies even deposit their eggs on the fungus, and the maggots seem to develop as though nourished by its substance. On examination Mr. Fulton found the spores adhering in thousands to the feet and proboscides of the insects. Their excrement he found to consist almost entirely of spores, and the latter were proved by experiment to be still capable of germination. There is therefore no doubt in this case that flies are employed as agents in the dispersion of the fungus. This statement also applies to various Coprini and others with a deliquescent hymenium. The spores of Coprinus fimentarius are ultimately contained in a slimy liquid substance having a fœtid odour and eagerly sought after by flies. In this species the pileus becomes revolute and fissured at its margins whereby it acquires a curious superficial resemblance to the flower-heads of some composites, the brownish centre corresponding to the disk and the marginal segments to the white florets of the ray.

THE PLAIN OF PRUSSIA.

By Grenville A. J. Cole, M.R.I.A., F.G.S.

Holland is known as a flat country, where architects have admirable chances; and the same type of scenery continues for some distance to the east, barns, church-towers, and windmills forming the main features of the landscape. When, after some feeling of monotony, and nine hours in the express from Vlissingen, we come in the afternoon to the desolate heath of Lüneburg, we seem about to meet with wilder things. The large undulations of this sandy watershed look mountainous after a morning spent in Holland; vague and perishable roads wander across them; and here and there a single figure, some lost soul of an agriculturist, appears ploughing the soil, which, but for him, would be a heathery and hopeless waste. The railway and the adjacent *Kaiserstrasse*, which is paved with blocks of stone to give it some rigidity, seem the only signs of civilisation.

Yet in time we come to the Elbe, and the forest of masts at Hamburg, and industrial Germany seems to spread before us. So far, in reality, we have only crossed the fringes of the plain. If we follow it to the Russian frontier, our ideas of its magnitude will certainly grow more precise.

The extraordinarily uniform nature of the landscape makes it almost inevitable that one Power should seek to hold this country from the east end of the Baltic to the west, and away beyond, even to the coast of Holland. One by one the minor states have yielded, and the unscientific frontier of Holland still keeps her open to future attack, either by diplomacy or arms. The first political sign of this Baltic uniformity was the establishment, in the thirteenth century, of the Hansa League, which bound the scattered seaports into one powerful federation, ready to defy the Danes and Scandinavians on the north, and to make their own terms with the imperial forces on the south. To this day the Hansa towns form the glory of the Baltic coast.

Once outside the towns, however, the features of the great plain begin afresh. A few miles east of Hamburg, with our backs to the great Lüneburg Heath, which goes off in waves beyond the horizon, we are out in the enormous meadows, where a hundred head of speckled cattle graze within a single field. The red brick towns are succeeded by red brick or timber villages; stone is far too valuable to be used elsewhere than on the roads. The village streets are paved with permanent blocks of granite, syenite, diorite, or other crystalline rocks; the *Kaiserstrassen* are macadamised with uniform fragments of the same materials. Here and there some hillock or cutting reveals the underlying substance of the plain, sand or loose earth in which pebbles and boulders are abundant. In the few places where the bed-rock is known below these layers of detritus, it is not such as to yield pebbles of crystalline rock by any process of decay. Dr. Wahnschaffe* has collected the records of some five hundred borings through the superficial deposits, which reach in many cases a thickness of fifty, and sometimes even of two hundred metres. The beds penetrated lower down are in a few instances of Triassic age, but far more commonly are Cretaceous or Cainozoic. In no case are granitic or even volcanic rocks recorded. White chalk, as is well known, comes to the surface in the cliffs of Rügen on the Baltic; but crystalline masses must be sought in the Harz Mountains or on the borders of Bohemia.

The boulders of the great plain of Prussia are not, how-

* "Die Ursachen der Oberflächengestaltung des norddeutschen Flachlandes" (1901), pp. 18—59.

ever, even of German origin. They prove, as was fairly recognised a century ago, to belong to Scandinavian masses; practically, they have been spread across the land from Sweden. Far from being a product of the waste of Central Europe, as one would suppose from the present direction of the rivers on its surface, the plain represents the filling up of a depression by the flow of material from the north. How has this material crossed the Baltic, and formed, as it were, a widely stretching delta abutting on Saxony and Bohemia? Surely the deposition should have taken place where the Scandinavian streams meet the sea, and not against the opposite shore?

Setting aside some early views, which maintained that the boulders were volcanic bombs showered out from seething caldrons in the north, geologists were led to believe that flood-waters had swept down from Scandinavia; and, later on, it seemed still more easy to account for the drifted material by the agency of floating ice. This explanation would require the submergence of the whole Prussian area in glacial times beneath an extended Baltic sea, the existence of which is at least dubious. At the same time, it leaves the long eskers and other features unaccounted for. The intercalations of marine layers among the "drift" deposits of North Germany are, however, sufficiently numerous to make one regard the area as once occupied by shallow bays and inlets on a shore formed of glacial accumulations. As the ice spread from the north, the earlier deposits were overridden, and no further marine beds could be laid down until the glaciers again retreated. As the ice melted, the burden of stones and sand, largely carried within its mass, became added to the drift and obscured much that had gone before. Making every allowance for the loss of some marine deposits and the effectual concealment of others, it seems, nowadays, impossible to maintain the view that the drift of North Germany, as a whole, was deposited by floating ice. At one time or another, solid ice, highly charged with Scandinavian *débris*, seems to have spread across the whole Baltic region and far towards the central European highlands. Prof. James Geikie's map* represents the extreme position reached by certain glacialists, and is enough to arouse criticism, and to make the supporters of the marine view seek for loose rivets in his armour. Dr. Scharff,† who enters the lists against him, does so mainly on climatic grounds, and urges that certain species of the European fauna have survived (in Ireland, for example) from Pliocene times onward, and that no ice-invasion has occurred over Northern Europe sufficient to crush out animal and vegetable life. He is thus led to regard the German drift as a marine deposit, and the Irish and British glaciers as local phenomena. Neither Dr. Scharff nor the believers in the frequently recurring warmer "inter-glacial" epochs seem to make sufficient use of the well-known Malaspina glacier of Alaska,‡ which spreads out on almost level ground, moving and melting so slowly that abundant vegetable and animal life finds a place upon its surface. It is well to remark, however, that modern observations in high latitudes agree in showing us beds of glacial drift deposited in shallow seas, and subsequently lifted above the water; the Chaix Hills of Alaska are among the most conspicuous examples, and reach 3000 feet in height. Hence both the advocates of continental ice-sheets and those who invoke the sea may find support when they study "existing causes of change." It is not difficult in this controversy to suggest the golden mean; whatever the former elevation both of Scandinavia and Central Europe may have been in early glacial times, it is clear that the floor upon which the ice oozed forth was swaying slowly up and down somewhere near the level of the sea.

When we learn that the rock-floor, which is generally hidden in this area, bears on it the grooves and striations first noted by De Saussure, and now so universally associated with the passage of glacier-ice, we must incline strongly towards the view that ice-sheets have occupied the plain. Dr. Wahnschaffe,* to whose work the present article is so greatly indebted, shows on a map how glacial striæ have been again and again found on rock-surfaces, under the covering of "drift," even so far south as Saxony. Some local glaciers from the Erzgebirge have naturally to be considered when we get into the Dresden area; but the general conclusion of German geologists at the present day is that the Scandinavian ice spread, at one time or another, as a vast sheet over the whole Prussian plain, and deposited its boulders at heights of 415 metres on the Saxon foothills, and even at 426 metres in the Riesengebirge to the east.† The exact figures, however, give us little idea of the thickness of the ice or of the slope over which it moved, seeing how many oscillations the plain of Germany has undergone, in company with the mountain-masses to the north.

If we seek for evidence of these oscillations, and of their impressive magnitude, we may find it in the recent researches of Prof. W. C. Brögger,‡ who urges that considerable submergence took place even while the ice was melting from the margin of southern Norway. The ice-rim thus dropped its burden of sand and boulders§ into a sea in which boreal, but not necessarily arctic, molluscs lived; and here again, as is so often recorded, stratified shell-bearing gravels result, of marine yet at the same time glacial origin. These, by the last emergence, are now lifted high and dry upon the coast-lands. But beneath them the distinctly striated rock-floor stretches seaward, showing that continuous ice occupied the place of the sea in still earlier times, banking it out from the land, or moving over dry ground when Scandinavia was more elevated than now. All these considerations must weigh with us when we set out across the Prussian plain. Broadly, then, we may feel that certain later deposits should be regarded as submarine stratified moraines; yet we cannot overlook the preponderating evidence that a huge confluent glacier-fan once spread across the country.

The phrase *moraine profonde*, applied to the deposits that come to light on the melting of an ice-sheet, has received different meanings during different stages of research. At one time it was presumed by extreme "glacialists" that boulder-clay was at one and the same time accumulated and thrust forward under the ice itself, as a sort of product of the rasping away of the country over which it moved. Modern observation on existing ice-sheets convinces us that the quantity of material which may be carried in the body of the ice, appearing as the mass melts, and becoming stratified by the accompanying wash of water, is quite sufficient to account for boulder-clays and other drift deposits. Such beds have thus a dual origin, and their final disposition is due more to water than to ice. Probably the *moraine profonde* of modern authors must be interpreted as this englacial

* "The Great Ice Age," ed. 3 (1894), Pl. IX., p. 437.

† "On the Origin of the European Fauna," *Proc. R. Irish Acad.*, Ser. 3, Vol. IV. (1897), pp. 488-502. Also "The History of the European Fauna," *Contemp. Sci. Series* (1899), pp. 80—86.

‡ *Thirteenth Ann. Rep. U.S. Geol. Survey* (1892), pp. 19, 26, and 67; *see* also KNOWLEDGE, Vol. XXI. (1898), p. 219.

* *Op. cit.*, Plate 2, p. 91.

† See Jas. Geikie, "Great Ice Age," ed. 3, p. 438.

‡ "Om de senglaciale og postglaciale nivåforandringer i Kristianiafeltet," *Norges geol. undersögelse*, No. 31 (1901), p. 690 (English Summary).

§ *Ibid.*, pp. 687 and 689.

material, which only accumulates as a true deposit when the glacier vanishes away. In this sense it differs considerably from the visible and continuous sheet of moraine-matter which disfigures and conceals the surface of so many glaciers. In this sense also, the material of the Prussian plain may be spoken of as largely originating in the *moraine profonde*.

And what is this plain to-day, stretching far into Russia on the east, but a monstrous development of the drift-covered plain of Ireland? The features seen between Dublin and Galway are here spread out over 500 miles; and that distance only brings us to the further frontier of Ostpreussen. By that time we shall probably have had enough of plains. Yet the surface is not truly level, for rounded hills of loam and sand, stuck full of the characteristic pebbles, occasionally border the road, or are climbed by it between one tract and another. In time we cross the Oder, in its alluvial meadows, between Stettin and Damm, whose harbours are forty miles from open water on this dreary and encumbered coast. In eastern Pomerania the monotonous poverty of the landscape becomes more intense. The forests form the one ennobling feature. Mile after mile of tall slim fir-trees, covering the sandy soil, rising in folds with the undulations of the surface, cutting off the grey-green Baltic on our left and the grey-green lands upon our right, and hiding us, as it were, in ancient Europe, far from the stir of modern times. The bitter wind, which blows even in September, sways the crests of the trees and crashes the stems against one another. The noise overhead, as we rest in the half-darkness, is in strange contrast with the quiet of these forest-depths. Here and there a soft by-road goes off to some well-hidden hamlet; it is the sort of track that in Poland they call a *polska droga*, the typical road of a primitive and undeveloped land.

And so again into the open, to meet the blast that bears with it rain-storms and sudden hail. In the sun-gleam that follows, a cold Baltic sun-gleam, the fields show their patches of brown earth and yellow sand; the ploughing, on such thin soil, does not obscure the boundaries of the underlying drifts. The precious crystalline boulders from Sweden, the handsomest things in the great plain, are removed by the labourers and placed conveniently against the highway. When the Pomeranian highland is reached, where the ground rises at last some 600 feet above the sea, lakes become more numerous, and one may climb for fifteen miles and descend for another fifteen, while the villages adopt almost a châlet style of architecture.

We had thought of the Vistula as the frontier of German preponderance; but both sides prove that the racial lines are as uncertain as the stream itself between its banks of yellow earth. The great waterway is, however, a feature in itself, with cliffs above it in places 200 feet in height, and the antique towers of Mewe or Marienwerder looking out upon the stream. The course of the river from near Bromberg to the Baltic is, geologically speaking, modern. All across the plain, the great rivers receive their longest tributaries from the east.* These, such as the Spree and the Warthe, run so far back from the main streams that it seems as if a trifling further extension would unite them in one great westward-flowing river, leaving the lower Vistula and Oder "beheaded" and diminished. Yet the course of events has been in reality in the opposite direction. The tracing out of the alluvial deposits in old valleys across the plain shows that the great east-and-west river has already existed, and that the lower courses of the Vistula and Oder result from the flowing out north at a later period of water that once found its way into the Elbe.* The Bug, rising in eastern Galicia, joins the Vistula near Warsaw; its waters formerly, as now, followed the present valley of the Vistula as far as Thorn and Fordon, but thence ran on west along the course of the present Netze and Warthe to the valley of the Oder; thence, still westward, to the Elbe near Havelberg in western Brandenburg, and so away to the North Sea. After a time, the water escaped north at a point in Brandenburg, and the lower Oder was formed, flowing to the Baltic; still later, a narrow breach was opened near Fordon in Westpreussen, and the lower Vistula drew off the more eastern part of the water, the former link with the Oder becoming converted into the present Netze. Thus it happens that only diminished streams occupy the ancient valley, while the main flow from the northern flanks of the Karpathians is poured by Fordon, Neuenburg, and Mewe into the Gulf of Danzig. Whatever valley previously existed here has been deepened by the greater flow turned into it, and the notches cut by old tributaries can be seen, left behind, as it were, high upon the yellow cliff.

This diversion of the streams northward, so noticeable on any map of Prussia, has been attributed to local alterations in the tilt of the land, such as are known to have gone on even since the deposition of the drift. A more general cause has been sought in the retreat of the dominant ice-sheet towards the Baltic basin; until this melted away, the rivers could only run east and west along its front. It is conceivable that the retreat was assisted by a downward movement of the Baltic area, and the formation of a slope on which new streams ran towards the ice-front and not away from it. The present river-courses, whatever their origin, clearly arise from the intersection of two separate systems.

At present, modern alluvium is spreading across the wide valley of the Vistula. Thus the old red fortress of Marienwerder, planted on the eastern bank, is two-and-a-half miles from its ferry; and when we cross the river, another level mile brings us to the western bank. At Neuenburg, the town rises directly from the stream; but five miles of alluvium must be traversed before we reach the corresponding cliff upon the east. These figures convey some idea of the scale of the valley, which forms the one great scenic feature of the Slavonic lands of Prussia.

We climb to Marienwerder, and again go eastward. A certain infatuation, such as Napoleon felt in the dreary days of 1806, draws one to the Russian cordon. Enormous ploughed lands, with occasional woods, and lakelets bounded by heaps of glacial drift, are succeeded near Löbau by quite a highland country, in places 800 feet above the sea. Long eskers, the gravel ridges that represent the channels of sub-glacial streams, cross the route, and again remind us of the inland ice. Their association with lakes recalls on a large scale the desolate moorland of Tyrone. Beside the road, boulders four or five feet long are piled up in cairns, while smaller ones peep out everywhere on the surface of the fields.

At length, in a purely Polish country, we reach the cordon and the black and white Russian frontier posts. For eight miles we ride down the border, on a true *polska droga*, through Bialutten, Dzwierzna, and Sczepka, often between the stems of the fir-trees rather than on the deeply grooved and sandy road. Over there, a stone's-throw on our left, the Cossack lancers, in their white shirts and caps, ride to and fro, and keep that arbitrary and unfenced line, which marks the edge of Europe. And here are Illowo and the railway-station; the gate of another Poland opens, and in four hours we shall be in Warsaw.

* Compare Kirchhoff, in Mill's "International Geography" (1899), p. 270.

* Wahnschaffe, *op. cit.*, pp. 175-191, and Pl. 2, p. 91.

XUM

DISTANT WORLDS.

II.—A REVIEW OF SOME RECENT STUDIES IN STELLAR DISTRIBUTION.

By C. EASTON.

WE have just seen by the aid of Stratonoff's charts that if we consider the Argelander stars (mag. 0—9·5) projected on the Milky Way, the great majority of these stars are not scattered in little groups irregularly spread over the whole Galactic zone; but that they are grouped for the most part in a few somewhat large condensations (three or four in the northern hemisphere), whose configuration is not much modified for stars below the 8th magnitude. But here an important question is presented. These great stellar condensations, in Cygnus, Auriga, &c., are they not effaced as soon as we take into consideration the innumerable numbers of stars fainter than those in the "Durchmusterung," that is to say, the multitude of stars of which the Milky Way, properly speaking, is above all composed?

We have already an indication that it is not so; the distribution of stars visible to the naked eye is quite different, whilst a simple inspection of the charts of the Milky Way shows a great analogy between the image formed by the entirety of the small stars and the distribution of the lower classes of Argelander. An interesting research, executed in 1893 by the German astronomer Plassmann, also anticipates the results to which Stratonoff leads us. And I had commenced an enquiry with the object of elucidating this question of a possible "correlation" between the distribution of stars of a medium brightness and the very feeble ones, when Stratonoff's atlas appeared, greatly facilitating my preliminary labours, whilst necessitating the rehandling of the Russian astronomer's data to make them comparable to the values indicating the distribution of the "Galactic stars."

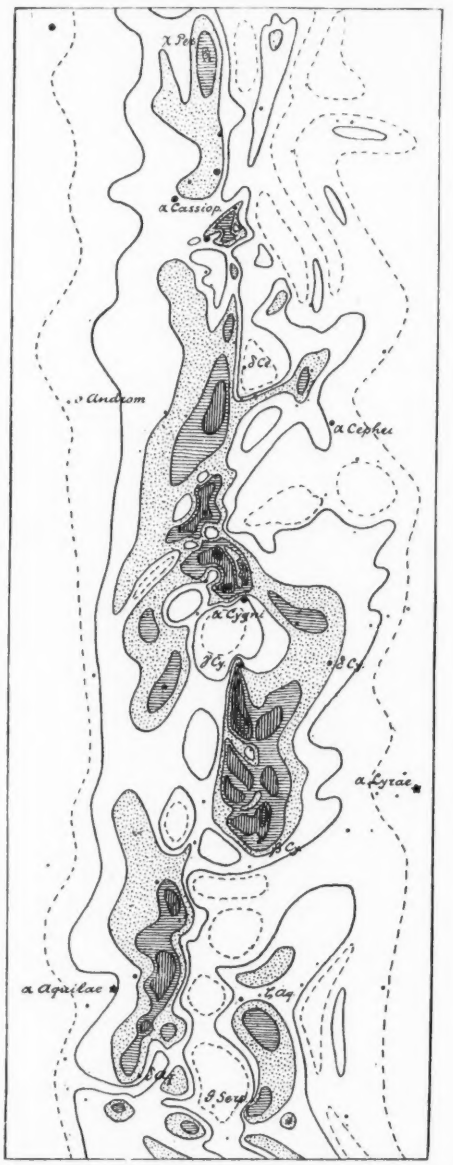
In order to estimate, as precisely as these researches admit, the distribution of the very small stars in the Milky Way, I first constructed an *isophotic* chart of the Galaxy, following the example of the Belgian astronomer, J. C. Houzeau, in 1876, but working according to a different method so as to obtain a much more detailed chart. This chart for the part of the Milky Way which extends from Aquila to Cassiopeia is published here for the first time. Here the curves do not represent, as on the charts of Stratonoff, lines of equal stellar density, but lines of equal brightness (isophotes) of the Galactic light. From this chart I was able to deduce, by a method too lengthy to give here,* numerical values representing the intensity of the Galactic light for equal surfaces of a given size, into which the Galactic zone had been divided, and it is evident that when these values are compared with those obtained for the stellar density of the Argelander stars, calculated for the same surfaces, the divergences which may appear should be attributed to extremely faint stars. We have thus a means of evaluating the richness of the Milky Way in feeble stars, and the particular distribution of these small stars.

But from such a comparison it appears, first of all, that the great condensations of stars that begin to be seen in those of the 8th magnitude are faithfully reproduced—taken as a whole—in the very faint "Galactic stars." This agreement, made by the aid of numerical values, is of much greater weight than the similar conclusion which was already drawn in a general way from the comparison of the charts of the Milky Way with those of Stratonoff.

What is the significance of this phenomenon?

* The detailed account of these researches will appear shortly in the *Proceedings of the Royal Academy of Sciences of the Netherlands.*

In the first place it is evident that it is not compatible with the supposition that, in the parts of the universe accessible to our observation, the stars, so to speak, form islands in the ocean of space; a great number of isolated groups, *separated from each other by intervals considerable*



Isophotic Chart of the Milky Way from Cassiopeia to Aquila.

as compared with the dimensions of the groups, a supposition which, according to many astronomers, agrees best on the whole with what we know of the structure of the universe. For, in this case, in proportion as the telescope or the photographic camera penetrates deeper into the stellar universe, new accumulations should make their influence felt, and should destroy the image of the stellar distribution produced by the stars nearest to us, and which form but an insignificant fraction of the whole. (All of Argelander's stars constitute but the hundredth part of the whole of Herschel's stars.) On the contrary, we have

seen that for the immense majority of the small stars and for those relatively brilliant, the condensations are found to be sensibly in the same regions of the Milky Way.

Again, a uniform distribution of stars that are sensibly equal (Herschel's first hypothesis) is manifestly opposed to what we have found, for in this case we should have to admit that a series of condensations extends, by chance, very far exactly in the line of sight.

Moreover, we may doubt whether we should have here to do with *real* condensations. For we must not forget that if the stars are really of very different brightness, a fairly considerable extension of our system along the line of sight in the direction A, compared with the depth of the system in another direction B, should, according to the laws of probability, produce an apparent excess in the number of stars of all classes in A (even for fairly bright stars, some of which would thus be distant, but in reality exceptionally brilliant or voluminous). And from what we know of the nearest stars, and from the researches of Prof. Kapteyn, it is evident that the differences of actual brightness of the stars are enormous.

But, on the other hand, there is evidence of more than one kind that there really exist in our system condensations; that the "clustering power" already recognised by William Herschel has produced its effect. We have first the theoretical considerations of Celoria, Seeliger and others, bearing on the fact that the Milky Way (actual) is placed in a part of the universe where the stars approach more nearly to each other; then we know there exist a great number of clusters, and that, moreover, they abound in the Milky Way; and, lastly, we have evidence of another order, perhaps less conclusive than the evidence based upon numbers, but not to be despised,—that furnished by photographs. We see there a structure, such that its accumulations must be admitted to be real, with dark lines, the "dark lanes" which have all the appearance of true fissures, as Mr. Maunder has already pointed out.

Thus we may start with two well-based suppositions:—(1) The considerable inequality of the stars in real brightness; and (2) the existence of veritable accumulations of stars. I have wished to exclude at first all suppositions relative to distance.

With the aid of these two suppositions we can explain in effect the principal phenomena of the apparent distribution of the stars. Nevertheless—and this is a fact which seems to me important—these two suppositions are not sufficient to offer a plausible explanation of certain facts brought into evidence in the researches mentioned above. Thus the composition of the Milky Way, its proportional richness in brilliant or faint stars, is very different in different parts of the zone. Whilst the great stellar concentration in Cygnus is already shown in stars relatively bright, another region as dense in Auriga and Monoceros is only evident in stars of the 8th or 9th magnitude, whilst the region between Sagitta and Sobieski's Shield—so brilliant, however, in the Milky Way—only begins to appear in Argelander's last class (9·5), and does not become conspicuous, as is demonstrated in the foregoing researches, until we come to the much feebler stars considered by Celoria (11th magnitude). On the other hand, the structure of the condensations in Auriga and Monoceros is much more homogeneous than that in Cassiopeia and Aquila. Those differences cannot be attributed with any show of plausibility to irregularities of the composition or the condensation of these regions of the Galactic zone; here it is that differences in distance come into play.

The appearance of the northern Galactic zone in drawings of the Milky Way show besides that the whole region between Cassiopeia, Ophiuchus and Aquila is separated fairly clearly by a region in Perseus, thinly star sown, from the other Galactic region which extends over Auriga, Monoceros and Canis Major. In the first region, as we have said, the branch which passes through Aquila and Sobieski's Shield seems more distant than the remainder; but, on the other hand, it has an excess of stars fairly bright or even brilliant near Cepheus and between this constellation and the very crowded region in Cygnus. It is as if this region, extraordinarily rich in stars, brilliant ones as well as feeble, in Cygnus forms a nucleus, from which come off streams which first—in Cepheus—approach the sun, to curve round again, receding more and more when in Cassiopeia, Cygnus and Aquila; to traverse the whole southern hemisphere, ending in Canis Major and Auriga; from this great arm there detach branches into Ophiuchus, Scorpio, etc. The sun is situated inside this gigantic spiral, in a comparatively sparse region of the system between the central nucleus and Orion. Relying on other considerations, developed among other places in KNOWLEDGE (March, 1898), I am disposed to think that such is indeed the structure of the Galactic system; but this view does not allow of a rigorous demonstration.

It may be objected that one of the results of Prof. Kapteyn's, in conformity with the conclusions of B. A. Gould and Schiaparelli, seems not to be in accord with such a disposition of the stars of our Galactic system, for, following these conclusions our sun would form part of a secondary cluster. But we must observe that there may well exist little clusters (Gould computes the number of stars in the solar cluster at seven hundred) in the sparse region of the system, and, besides, Prof. Kapteyn has lately abandoned this idea of a "solar cluster" to which he had been led by considerations, recognised as erroneous, of other astronomers on which he had based it; and as for the conclusions of Gould and others, as these are based exclusively on the apparent brightness of a small number of stars, they have not any great weight.

Prof. J. C. Kapteyn (the well-known collaborator of Sir David Gill, founder of the Astronomical Laboratory at Groningen, and medallist of the Royal Astronomical Society) has continued in the last few years the important researches which Mr. Gore and Miss Clerke have published in their lucid papers in KNOWLEDGE. We know that Kapteyn sees in the distribution of the proper motions of stars a means of increasing very materially our knowledge of the Galactic system. He takes extreme care to eliminate every inadmissible hypothesis and every source of error. And lately Prof. Kapteyn has been occupied with a new method of determining a great number of stellar parallaxes in the same region of the sky, and it goes without saying that a more extended knowledge of stellar parallaxes may lead us to decisive results of the highest importance.

Unhappily, the results obtained so far by Prof. Kapteyn in his last researches scarcely let themselves be extricated from the technical gear of formulæ; and, besides, the researches are not yet finished, and we may not anticipate the result. Thus I will confine myself to mentioning that Kapteyn has succeeded in establishing a formula to express the mean parallax of stars of a given proper motion and brightness, and that he, from this, finds the relative frequency of stars of a determined absolute brightness. In his last publications,* he arrives at the conclusion that the density, the richness in stars of stellar space is much greater than is ordinarily represented; that there exists an excessive number of stars of feeble brilliancy. Kapteyn gives, for example, the following values:—If we conceive

* J. C. Kapteyn: *Public. Astron. Laboratory, Groningen*, VIII., 1901; *Proceedings Royal Academy, Amsterdam*, 1901.

of a region of space containing two millions of stars of the same magnitude as our sun, we shall find that there are 500,000 stars more brilliant, but 12,500,000 stars fainter than our sun.

From the very succinct *résumé* that I have just given of the researches on the structure of the visible universe effected during the last few years—and I have said nothing about the distribution of the nebulæ so as to economise space, though this is a subject very intimately connected with the constitution of the stellar system—it will be evident, I hope, that not only has there been much new material brought together, but that it is possible to draw several interesting conclusions from them.

Perhaps after some years of assiduous work it will be possible to establish more firmly on this ground of truly international scientific effort conclusions which at present are vague and doubtful; perhaps we shall soon see a little more clearly into this sublime mystery of the structure of the universe. In any case, a corner of the veil which has covered it through so many centuries has begun to be lifted.

JUPITER'S GREAT RED SPOT AND ITS SURROUNDINGS.

By W. F. DENNING, F.R.A.S.

DURING the last quarter of a century no other planetary marking has incited so much interested attention and study from telescopic observers, as that familiarly known as "The Great Red Spot on Jupiter." The size of the object, the striking aspect it exhibited in the years from 1878 to 1882, its beautifully elliptic form and the extended duration of its visibility, have all contributed to render it a feature of exceptional character. It may, indeed, be almost regarded as unique, and it has certainly served an excellent purpose in stimulating enthusiasm and directing observers to the study of the physical changes affecting the leviathan planet of our system.

The spot has undergone some curious variations. It seems liable to temporary disappearance amid the sea of Jupiter's atmospheric vapours. But through all the vicissitudes and diversity which have affected it in recent years, it appears to have retained an oval shape and a nearly uniform size, though there is evidence to show that its dimensions are now somewhat smaller than formerly. It displayed an intense brick red colour in 1873, and also in 1878 and four following years, but it then faded into a lighter tint, and, subsequently, became an elliptic ring which showed signs of further decadence. Lately, the spot has almost suffered obliteration, having resolved itself into a faint dusky stain, darkest at the following end, and forming but a very feeble relic of the magnificent object presented to us nearly twenty-five years ago. The eye is directed to the exact position of the marking by a remarkable irregularity in the southern side of the southern equatorial belt, in which there is a large bay or hollow immediately north of the spot and partly enclosing it.

Old observations have not yet been fully investigated, in order to determine the date when the red spot first impressed itself upon the face of the planet. Under the circumstances this will be a difficult point to decide, owing to the want of continuity in the observational evidence. Robert Hooke, on 1664, May 9 (O.S.), was undoubtedly the first to discover a large dark spot on the southern hemisphere of Jupiter; but he does not appear to have made any further observations of it. J. D. Cassini, fortunately, re-detected the object in the summer of 1665, and watched it during subsequent years. He ascertained that its period of rotation was 9h. 56m., and that it had a somewhat precarious existence, for it alternatelyappeared and disappeared at irregular intervals.

Was the spot discovered by Hooke in 1664, and studied by Cassini in later years, identical with the feature which has enlisted such widespread interest in our own day? There is evidence strongly countenancing the supposition of identity. The latitude of Hooke-Cassini's spot was the same as that of the great red spot, and the motions of the two objects appear to have been approximately the same. But the ancient marking was a roundish object described as one-tenth of the apparent diameter of Jupiter, while the great red spot is about one-fourth In fact, while the old spot was about 8000 miles in diameter, the present one when most conspicuous was 26,000 miles long and about 9000 miles wide. These differences occasion doubts, without, perhaps, absolutely negativing the theory of identity. Possibly, with the lapse of time, the spot has distended its material in a longitudinal direction as a result of the swift axial rotation of the planet.

In past years there are many breaks in recorded observations of Jupiter, and this is particularly the case between the results of Maraldi (1713) and Sylvabelle (1773). Thereafter W. Herschel, Schroeter, Mädler, Schwabe, and others obtained a considerable number of observations. But there are many missing links and not a few contradictions. It is, however, hard to believe that the red spot could have been plainly visible during the last twenty years of the eighteenth century, and yet have escaped the special notice of Herschel and Schroeter.

Schwabe's drawings in 1831 appear to be the first unmistakably showing the hollow in the belt, which in recent years has contained the red spot. Our knowledge of the aspect and position of the latter enables us to follow it, notwithstanding its extreme faintness. Seventy years ago, when Schwabe's earlier observations were made, the appearance may have been precisely similar to that exhibited at the present time, in which case the feeble ellipse, inlying the hollow, would easily have been overlooked in Schwabe's telescope. Schwabe frequently delineated the hollow under conspicuous outlines between 1831 and 1856, and this feature probably owes its existence to repulsive action exercised by the red spot. It is, however, rather curious that, while the belts north of the spot evade and bend abruptly away from the latter object, the southerly belts occasionally bend towards and coalesce with it.

The red spot is a boat-shaped object (as seen from a vertical position), and it floats in a wide current situated from about 20° to 35° of south latitude. This current has always given a very equable rate of velocity, and the rotation period has been found to be 9h. 55m. 19s. Dark and white spots, and various irregularities on the belts marking this region, all participate in this velocity, but the red spot shows a singular departure from the rule, for it travels slower than the involving stream, and loses 53 seconds per day (nearly half a degree), which is equivalent to about 370 miles. The spot is, in fact, like a great barge slowly drifting eastwards in a wide current. It is probable that the rate of neither the current nor the spot coincides with the exact rotation period of the globe of Jupiter. We have learned the period of the small planet Mars to the tenth of a second (24h. 37m. 22·65s.), for some of the markings displayed on the ruddy Martian surface represent permanent lineaments, which are invariably visible, though the atmosphere of that planet is apt to affect their appearance in some degree. But the conditions are very dissimilar in regard to Jupiter, forming, as he does, an immense orb probably in a very heated state, and with his real features masked by dense gaseous vapours undergoing frequent changes.

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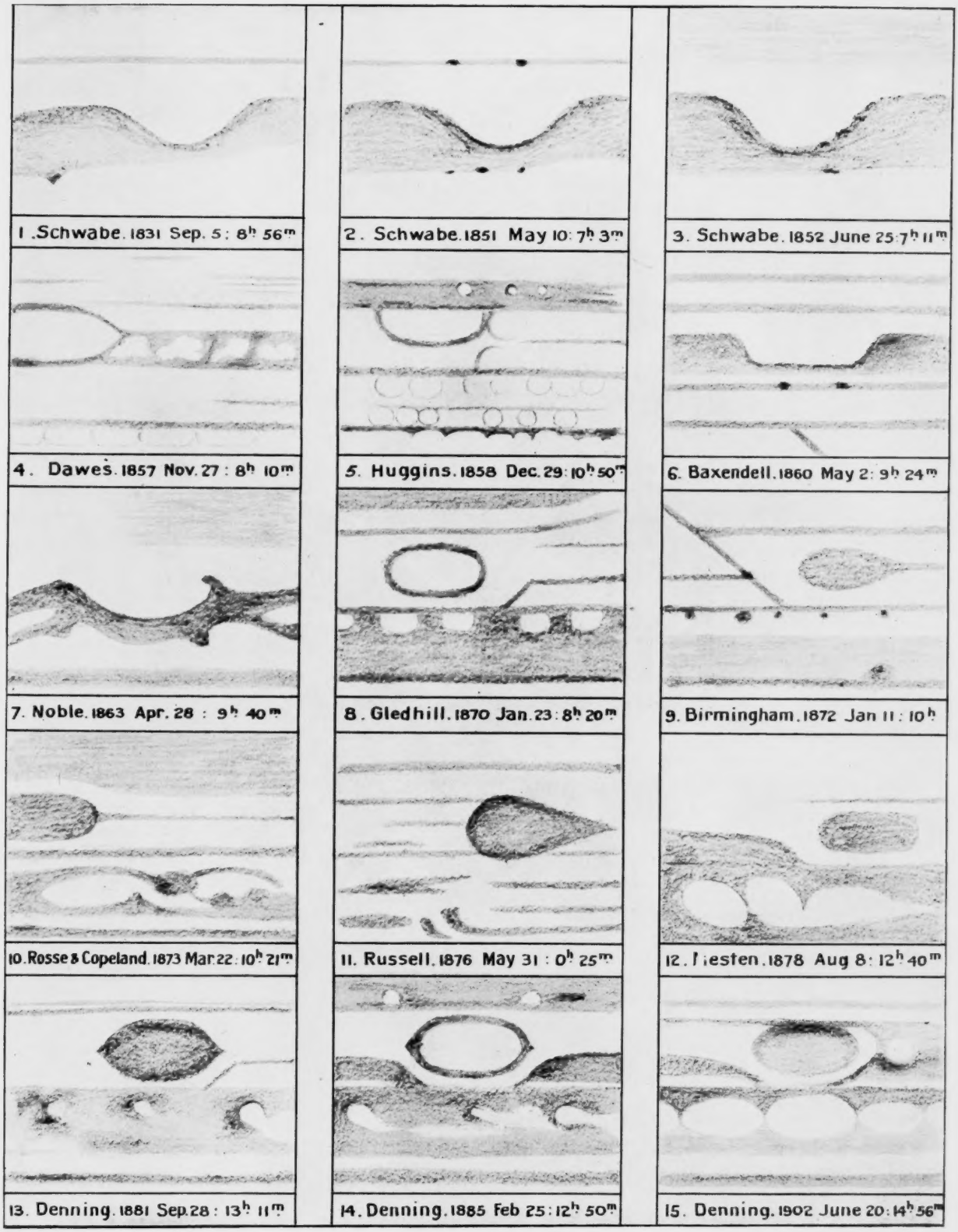
1. Schwabe. 1831 Sep. 5: 8h 56m
2. Schwabe. 1851 May 10: 7h 3m
3. Schwabe. 1852 June 25: 7h 11m
4. Dawes. 1857 Nov. 27: 8h 10m
5. Huggins. 1858 Dec. 29: 10h 50m
6. Baxendell. 1860 May 2: 9h 24m
7. Noble. 1863 Apr. 28: 9h 40m
8. Gledhill. 1870 Jan. 23: 8h 20m
9. Birmingham. 1872 Jan 11: 10h
10. Rosse & Copeland. 1873 Mar. 22: 10h 21m
11. Russell. 1876 May 31: 0h 25m
12. Niesten. 1878 Aug 8: 12h 40m
13. Denning. 1881 Sep. 28: 13h 11m
14. Denning. 1885 Feb 25: 12h 50m
15. Denning. 1902 June 20: 14h 56m

REGION OF THE GREAT RED SPOT ON JUPITER.

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Though the red spot is now very feebly visible, it may still be intact and in no danger of disappearance. The past history of the object is suggestive that we may expect a repetition of its formerly conspicuous aspect. The hollow in the belt is as strongly pronounced as ever. If it filled up and the south half of the double S. equatorial belt became continuous (without bend or break) in one and the same latitude throughout its circumference, then we should conclude that the material of the spot had really dispersed. But nothing of the kind seems imminent. The past behaviour of the features in this region indicates that when the red spot regains its former prominence the hollow and the southern half of the equatorial belt will decay and probably fade away to invisibility. Possibly the material evolved from Jupiter's heated surface is responsible for the production of the belts and spots on the planet; and the intensification of the belt north of the red spot means that the sustaining material of the latter is being diverted to the belt, whereupon the spot necessarily becomes very feeble. It is certain that the spot and the hollow in the belt have been perceptible either alternately or together ever since 1831, September, a period of nearly 71 years, and that the objects can be distinctly traced on a number of drawings made by various observers during that lengthy interval. And it is quite possible that these associated features of the planet were in visible evidence in the earlier years of last century though they do not appear to have been recognised and to have occasioned special notice.

The following is a general summary of appearances recorded at successive periods:—

1831–1856.—A large and well-defined hollow in the southern side of the southern equatorial belt.—Schwabe.

1857, November.—An elliptical object of considerable size resting upon the S. equatorial belt.—Dawes.

1859–1860.—A large elliptic ring in the southern hemisphere and situated between the S. equatorial belt and the S. temperate belt.—Huggins.

1860–1867.—A great depression or hollow in S. side of the equatorial belt.—Baxendell, Huggins, Jacob, Long, Noble and others.

1869–1871.—A large elliptic ring lying S. of the S. equatorial belt.—Gledhill and Mayer.

1872.—A large oval cloudlike object in S. hemisphere, between S. equatorial and S. temperate belts, and preceded by an oblique belt.—Birmingham, Browning, Gledhill, Knobel, Terby and others.

1873.—Great break in the S. side of the S. equatorial belt.* A brick-red area filled up this break. It was pointed at preceding end and rounded at following end. It extended over some 30 degrees of longitude.—Lord Rosse and Dr. Copeland.

1876–1877.—Large pink spot often seen on S. side of equatorial belt. Rounded at preceding end and pointed at following end.—Russell and Bredichin.

1878–1882.—Great elliptical spot of an intense brick red colour, seen just south of the S. equatorial belt. Length 34 degrees.—Many observers.

1883–1886.—Large elliptical ring situated in a well-marked dip or hollow on the S. side of the equatorial belt.—Many observers.

1887–1902.—Large faint dusky ellipse, varying slightly in tint and tone from year to year, and placed in a hollow in the equatorial belt. Darkest at following end. Outlines not distinctly traceable except on a night of good definition.—Many observers.

* The same object was figured by Mr. E. B. Knobel in 1873, April 20, and May 11, when it was on east limb (*Monthly Notices*, XXXIII., p. 476), but it cannot be satisfactorily identified in 24 drawings of Jupiter which he made in 1874 (*Monthly Notices*, XXXIV., p. 403).

The motion of the objects has been by no means uniform during the 71 years; in fact, there have occurred some curious oscillations, as the following brief summary will prove. Throughout the whole time, however, the spot and hollow appear to have exhibited identical rates of motion; a conclusion which is fully justified by the observations.

In 1831-2 the rotation period was about 9h. 55m. 33·5s., rising very slowly during the next 24 years, at the rate of about one-tenth of a second annually, until in 1855 it was 9h. 55m. 36·1s. Then the spot exhibited greater retardation, so that in 1859 its period had augmented to 9h. 55m. 38·3s. It then accelerated its movements, and the period declined quickly, until in 1862 it amounted to 9h. 55m. 35·3s. Remaining for some 17 years at about 9h. 55m. 34·5s., another retardation set in in 1879, increasing the period in 1885 to 9h. 55m. 39·6s. From that year the motion continued to exhibit a slight decrease until 1900, when the period was 9h. 55m. 41·9s. In 1901 a marked acceleration affected the position of the object, and the period decreased to 9h 55m. 40·9s. This was continued in 1902, and it seems probable that the motion will undergo a further acceleration in immediately ensuing years.

At the middle of 1894 the longitude of the spot coincided with the position of the zero meridian System II. (daily rate =9h. 55m. 40·63s.) of Mr. Marth's ephemerides. But the retarded rate of velocity during the following six years caused it to drift eastwards, until its observed longitude in 1900, September, was 44½ degrees, and it remained at this value in 1901 and first half of 1902. Should the motion of the spot now continue to increase, and the rotation period become less than 9h. 55m. 40·63s, the longitude of the spot and hollow will, at some future date, again exactly correspond with the zero meridian of System II., as it did in 1894.

In the chart the region of the great red spot is delineated, as it successively appeared at various epochs in and since 1831. It must be confessed that some of the features, as represented, do not offer a very striking similarity, but there seems little reason to question their identity. It is well known that drawings by different observers, owing to variety in method and individual conception, sometimes appear strangely discordant, and that the same details are represented under aspects which bear very slight mutual resemblance. If we allow for this personal equation in the matter of drawing, and for the actual changes which undoubtedly occurred in the objects, and virtually transformed them from time to time, the apparent inconsistencies will disappear. The positions and motion of the markings agree very well together. In one drawing by Sir Wm. Huggins, dated 1858, December 2, a large well-marked hollow was figured a little E. of the centre, but this would not accord with other results in 1857, 1859, and 1860, so that doubts were thrown upon the endeavour to satisfactorily trace back the history of the feature, for the drawing alluded to required the assumption that two hollows existed in the great southern equatorial belt. But it was soon afterwards found that by a clerical error the year 1858 had been assigned instead of 1860, and this being rectified, the position of the hollow was found to harmonize perfectly with other observations. All the collated material exhibits in fact a remarkable consistency, and forms a chain of evidence which appears to be conclusive, as to the identity of the features delineated by Schwabe and many other observers since his time.

In 1873 the red spot is described as pointed at its preceding end, while the opposite end was rounded. In 1877 this figure seems to have undergone reversal, for the sharp end was then on the following side. These alterations of

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aspect were probably not in the spot itself, but were brought about by the contact of the more swiftly-moving belts on the southern boundaries of the object. The dark end of a short belt or condensation (of which there are many examples in this region), when just preceding or following the spot, might readily induce the appearance of a tapering extremity.

The following selected observations of the hollow, in which the faint relic of the red spot is situated, will sufficiently prove that during the last two years the longitude has not changed relatively to the zero meridian, based on a rotation period of 9h. 55m. 40·63s. The first two transits were obtained with a 4-inch Cooke refractor, the remainder with a 10-inch reflector, power 312, by the writer at Bristol:—

Date.	Transit Time. H. M.	Longitude. °
1900, September 3	7 10	44·4
1901, February 13	17 37	43·5
May 28	13 35	45·9
June 24	10 46	44·7
July 20	12 9	44·8
August 9	8 38	43·5
September 24	6 46	44·5
1902, April 28	16 14	45·9
May 20	14 23	44·7
June 20	14 56	44·8
June 27	15 37	42·2
July 7	13 54	43·9
July 9	15 33	44·5

ASTRONOMY WITHOUT A TELESCOPE.

By E. WALTER MAUNDER, F.R.A.S.

XVI.—THE STRUCTURE OF COMETS.

In the chapter on "Morning and Evening Stars," I pointed out that the systematic observation of heliacal risings and settings offered a chance—a rare one, it is true, but still one not to be despised—of making the first discovery of a comet. Unfortunately comets, bright enough to be visible to the naked eye, have been but very scarce visitants, nor can we reasonably expect that they will be more numerous in the future. Still, when one does come, it justly attracts universal attention; and the "astronomer without a telescope" will naturally be anxious to know if there is any work within his power to effect upon it.

There is. He cannot of course expect to make useful determinations of the comet's place; nor can he scrutinise the changes which take place in the minute details of its head. But the shape, extent, and precise form and position of the comet's tail are better observed by the naked eye than with the telescope; since the eye can embrace a far wider field, and is the fitter instrument for dealing with great extensions of faint light. To map out, night by night, the precise position of the tail or tails with reference to the neighbouring stars, to trace its limit and to determine its exact form, are by no means unimportant tasks.

And for this reason. The last thirty years have seen the development and gradual acceptance of a theory which explains the origin and structure of those far-stretching wisps of light which our forefathers found so mysterious and awe-inspiring. The first step towards the elaboration of this theory was made by Olbers nearly a century ago in a memoir on the great comet of 1811; but in its present shape we owe it to Prof. Brédikhine, lately the Director of the Poulkova Observatory.

It was very early noticed that the tails of comets are in general directed away from the sun, and the instance of certain comets, which passed at perihelion very close to the solar surface, was sufficient to prove that we must not regard a comet's tail as forming a body coherent with the head. Thus the great comet of 1843 swept round some

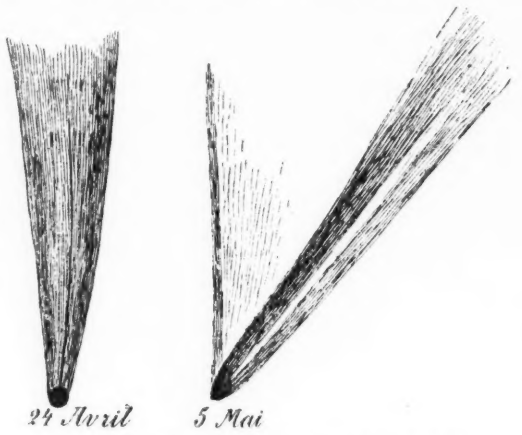


FIG. 1.—The Comet of 1901 on April 24 and May 5.

180° of longitude at perihelion in something like eighteen hours of time. The tail which had been seen before perihelion, pointing away from the sun in one direction, could not possibly have been composed of the same material as made up the tail, lying in the opposite direction after perihelion. But if it were supposed that the sun were capable of exercising a repulsive force upon some portion of the substance of the comet, driving it off in a continuous stream, then the general behaviour of cometary tails would be accounted for. The tail, seen at any

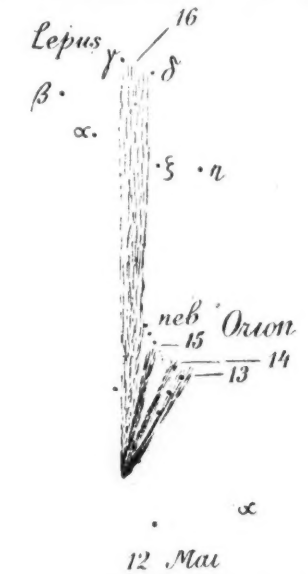


FIG. 2.—The Comet of 1901 on May 12.

particular time, would be the summation of particles which had left the comet at different successive instants, just as the trail of smoke from the funnel of a locomotive, as seen at any particular moment, is composed of particles that came off from it at successive instants, and is not a body coherent with the engine.

Such a repulsive force we may find in an electrical action of the sun, an action, the efficiency of which would depend upon the surface of the body acted upon; as contrasted with that of gravitation, which depends upon its mass. Thus whilst the nucleus is moving in its orbit round the sun under the influence of gravitation, very minute particles in the envelope will find themselves practically less strongly attracted towards the sun, or it may actually be repelled from it; in any case the effect is to separate them more and more from the main body of the comet.

Of the particles thus driven away from the head, the lightest would be those most strongly repelled; and Prof. Brédikhine found that several of the great comets of the past century were distinguished by the possession of long straight tails which must have been composed of particles moving under an influence some twelve or fourteen times

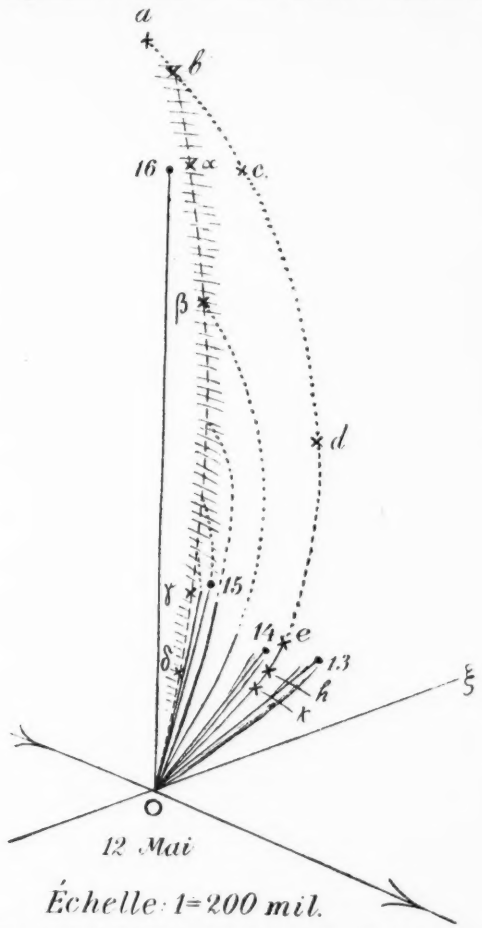


FIG. 3.—Prof. Brédikhine's analysis of the tail of the Comet on 1901, May 12.

that of gravity. These long straight tails form an exceedingly characteristic class, and have accordingly been ranked by Prof. Brédikhine as composing his first type. Such tails are obviously composed of the lightest material entering into the composition of the comet, and assuming this to be hydrogen, then the average tail of the second type might well be made up of hydrocarbons; whilst iron and the heavier metals would, from their molecular weight, be suitable elements to form the third type. In the tails of the second type the effective repulsive force does not differ greatly from gravity, and it is this type of tail, slightly, but not extravagantly curved, which is most commonly observed in comets visible to the naked eye. The third type is usually sharply curved, short and brush-like, and the repulsive force is considerably less than that of gravity.

The great comet seen in the southern hemisphere in April and May, 1901, has recently been analysed by Prof. Brédikhine, in a paper from which the three accompanying diagrams have been reproduced, and his results afford an interesting example of his method of treatment, and of the use which can be made of careful naked-eye observations of the positions of a comet's tail.

On April 24th, before the perihelion passage, the comet showed practically only a single tail, and that was of the first or hydrogen type. After perihelion, the tails were only of the second and third types, the matter composing the first type tail having been apparently completely driven away. On May 5th, the chief tail, which was distinguished by a very well marked rift, showed this rift as of a conical shape, the apex of which was occupied by the nucleus, and not as usual of a conoidal form. A drawing made by Mr. J. Lunt at the Royal Observatory, Cape of Good Hope, on May 12th, was of especial interest. It not only showed the principal tail of May 5th with its dark rift, but a long broad faint tail some 25° in length, and a short tail between the two. Prof. Brédikhine's analysis of this drawing is given in the accompanying diagram. The lines 13 and 14, the two branches of the principal tail, were due to a repulsive force a little greater than unity; the line 15 is due to a force of about 0·65; the broad faint tail, Prof. Brédikhine ascribes to substances of the third type, and finds that when the particles which make it up are traced back to the nucleus they indicate that a great explosion took place on April 22nd; a vast quantity of matter of a wide range of density being driven off in a single short-lived convulsion. The points in the diagram, α, β, γ and δ, correspond respectively to values of the repulsive force of 0·85, 0·65, 0·25 and 0·15.

Letters.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

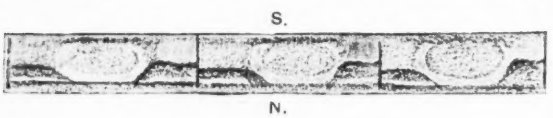
MARKINGS ON JUPITER.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—Last year there was a large dusky mass situated between the south side of the equatorial belt and the south temperate belt of Jupiter, and joining the two. In 1901, June 18th, the longitude of the marking alluded to was 258°, while on November 17th of the same year it was 176°. During five months it gained, therefore, 82°, its rotation period being 9h. 55m. 18·5s., while that of System II. of Mr. Crommelin's ephemerides was 9h. 55m. 40·63s. This dusky mass, placed in the usually bright tropical zone of Jupiter, is still conspicuously visible, and has greatly distended itself since last year in a longitudinal direction. On July 2nd I observed it with a 10-inch reflector, power 312, and found its *p.* side on the central meridian at 13h. 51m., while its *f.* side came to the C.M. at 16h. 16m., or 2h. 25m. afterwards, so that the formation extended over 87°·6 of longitude. At the present time it lies both E. and W. of the old red spot and hollow in the south belt, which is in longitude 43°.

Though the dusky mass is now passing the red spot, the latter is no darker than usual, and it seems highly

probable that the sombre material of the former as it overtakes the red spot is drifted abruptly southwards, flowing along its southern borders and then on reaching the *p*. side of the latter it turns sharply to north and thus occupies the same latitude both east and west of the red spot. The *f*. end of the south tropical (or temperate) mass



Red Spot and its Surroundings.

will come up to the *f*. end of the red spot at the beginning of September, and it will be important to ascertain whether the extremity of the former flows southward.

Telescopic observers should keep a diligent watch during ensuing months on the developments in this exceedingly interesting region of Jupiter.

Between 1900, September, and 1902, June, the mean motion of the red spot conformed precisely with the period of 9h. 55m. 40·6s. on which System II. of the ephemerides is based, for its longitude remained consistently at 44½°. Lately, however, the spot has indicated a slight acceleration in velocity, for its longitude appears to have decreased 2° or 3°, and it is likely that it will show a further decrease in succeeding months, for the past history of the spot sufficiently proves that it is liable to some marked fluctuations in its rate of motion.

Bishopston, Bristol, W. F. DENNING.
1902, July 4th.

A MODERN TYCHO.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—My attention has been called to an article by Mr. E. Walter Maunder in your issue of May, 1902, entitled "A Modern Tycho," in which the following sentence occurs :—"Jey Singh does not seem to have effected any reformation of the Indian calendar, and his observatories, despite their great size, cannot have been of much value for really scientific work."

I would ask your correspondent if he has ever seen an account of the "Zeech Mahommed Shahi," or Jey Singh's astronomical tables, published by him, after years of observation at his observatories, about 1728. In the preface to these tables Jey Singh states that the old Siddhantas give incorrect results, that at Mahommed Shah's request he had erected several observatories, and that after many years' labour he had succeeded in producing these tables according to the prediction of which the celestial phenomena take place exactly. He also adds that hearing astronomical observations were being made in Europe, he had sent thither to make enquiries, and that as a result he had obtained the tables of de la Hire, which on examination proved very inaccurate. There is an account of the "Zeech Mahommed Shahi," by Dr. W. Hunter, in "Asiatic Researches," Vol. V., but, as far as I know, these tables have never been thoroughly examined by an expert with a view to test their accuracy. I was informed the other day by a native astronomer, fairly well acquainted with the modern methods of practical astronomy, that these tables generally give results not often more than two to four minutes in error. If this is so, Jey Singh's work must have been of a high order, and of considerable scientific value. I hope to obtain a complete translation of these tables shortly, and have them properly investigated by a competent expert.

But, putting aside the question of the accuracy of these tables, there is no doubt that some of Jey Singh's astronomical measurements are as precise as have ever been attained by naked-eye work. The inclination of the face of the gnomon of the big instrument at Jeypore is within a minute of arc of its correct value. Jey Singh's determination of the latitude of Jeypore and Ujjain are certainly within half a minute of the truth, and possibly even closer, while the value he deduced for the obliquity of the ecliptic is of an equally high order of accuracy. The value he gives for the average annual procession is, if my memory serves me right, within a second of the modern determination.

During last summer I was engaged in restoring the observatory at Jeypore, and had ample opportunities for testing and investigating the instruments. Their accuracy was shown by the excellent agreement in the results obtained by observing altitudes, azimuths and declinations with different instruments. Jey Singh was a good mathematician, and wrote many works on astronomy and trigonometry. Under these circumstances it seems probable that the "Zeech Mahommed Shahi" are a very great improvement on the old Siddhantas, though possibly not possessing the accuracy which Jey Singh claimed for them.

Mr. Maunder writes rather disparagingly of Jey Singh, who, as I have shown above, certainly obtained very good results, and did the best he could for the advancement of astronomy with the limited means at his disposal. It should be remembered too that Jey Singh lived in very troubled times, and that the very existence of his State was constantly being threatened both by enemies from without and intrigues from within. Indeed, considering the state of affairs at the time, it is wonderful that Jey Singh ever found leisure for the erection of his observatories, and the writing of his books. A. FF. GARRETT, Lt. R.E.

India, June, 1902.

[I had no wish to disparage Jey Singh, who, as Mr. Garrett most truly says, lived in very troubled times in the which it was wonderful that he found the opportunity for accomplishing so much scientific work. But I think that Mr. Garrett has missed the point which I was really anxious to make. I have only had the opportunity of myself examining one of Jey Singh's observatories—that of Delhi—but I was much impressed with its limitations for really good observational work. The gnomon, after all, despite its great size, would have given no better determinations of time than a comparatively small sun-dial, while the circular buildings only permitted the observation of altitudes and azimuths of objects when low down, and I saw no indication that any great care was taken about the precise position of the observer's eye.

And the accuracy with which the various buildings are placed—as, for example, the inclination given to the face of the gnomon—so far from bearing witness to any improvement effected by the observatories, is proof just the other way. For Jey Singh must have determined the latitude of the place with this precision before ever he started to build; he could not have altered his gnomon afterwards. For this purpose he probably used quite a simple apparatus of poles fitted with sights; and it was the superior efficiency and range of usefulness of just such simple means that I had chiefly in view in my paper. Jey Singh's observatories are most certainly interesting, but they are scarcely practical.

I am glad to note that Mr. Garrett hopes to obtain a complete translation of Jey Singh's tables ere long; but I venture to think that it would be of even greater interest to astronomers if he would himself undertake a series of observation of stars and planets with the Jeypore instruments as they stand.—E. WALTER MAUNDER.]

NOTES.

BOTANICAL.—Parthenogenesis has been discovered by Mr. J. B. Overton in *Thalictrum purpurascens*, and is the subject of a paper in the May number of the *Botanical Gazette*. Another species (*T. Fendleri*) was suspected to exhibit this phenomenon. In 1896, Mr. D. F. Day wrote that he had grown pistillate plants of this species, and although no staminate plants of any species of *Thalictrum* were in the neighbourhood, an abundance of good seeds were produced. As it seemed doubtful whether this was a case of parthenogenesis or of vegetative apogamy, Mr. Overton undertook a careful study of the development of the embryo of *T. purpurascens*, in which fertilization could not possibly have taken place. He determined that in this plant fertilization is not necessary to embryo-development or to endosperm-development, that embryos were produced parthenogenetically under all conditions, and that the development of the embryo in parthenogenetic material is the same as in normal material.

Among the plants which are adapted by their peculiar habit of growth to serve the office of sand-binders and beach-builders, as illustrated by the British *Psamma arenaria*, is the extremely interesting Naiadaceous genus *Phyllospadix* or Eelgrass. This, as Mr. R. E. Gibbs states in his paper on the plant in the *American Naturalist* for February, grows in extensive beds in shallow water along the rocky shores of Bodega Bay, California. Its fruit is furnished with two arms, and after it has detached itself from the parent plant, these arms ultimately become barbed in consequence of the wearing away of the softer tissues through friction with rocks and stones, which exposes a series of elongated lignified cells. These cells stand out as strong barbs, enabling the fruit to anchor on branches of sea-weeds. It is commonly found on *Amphiroa*, the segmented stems of which provide a firm resting place. The seed then germinates, and gives rise to a thick mattress of rhizomes, covering boulders and binding stones, sand and other material firmly together, thus forming a "more coherent and stable foundation of the beach."—S. A. S.

ZOOLOGICAL.—In a paper published in the June issue of the *Proceedings* of the Zoological Society of London, Dr. Ludwig von Lorenz describes and figures a mounted specimen of a quagga preserved in the Imperial Museum at Vienna. As this example differs somewhat in its markings from other specimens, the author suggests that there may have been two or more local races of this now extinct species.

The fossil voles of the Norwich Crag and the Pliocene deposits of the Val d'Arno form the subject of a communication by Dr. Forsyth Major to the journal just quoted. The forms characterized by having rooted cheek-teeth the author proposes to designate by the new generic term *Mimomys*, naming one of them *M. newtoni*, in honour of Mr. E. T. Newton, the well-known describer of Crag vertebrates.

In concluding an account of his investigations on the phylogeny of the dentition of the hedgehogs and their allies, published in the *Zoologica*, Dr. W. Leche, of Stockholm, expresses the opinion that the European Oligocene genus *Necrogymnurus* is the oldest representative of the family known to us. From this have sprung two branches, one including the extinct *Galerix* and *Lanthanotherium* and the modern Bornean *Gymnura*, and the other the true hedgehogs (*Erinaceus*) and the Malay *Hylomys*.

Dr. Gadow, of Cambridge, in a paper on the origin of mammals contributed to the *Zeitschrift für Morphologie*, sums up as follows:—"Mammals are descendants of reptiles as surely as they have been evolved from Amphibia. This does not mean that any of the living groups of reptiles can claim this honour of ancestry, but it means that the mammals have branched where the principal reptilian groups meet, and that is a long way back. The Theromorpha, especially small Theriodontia, alone show us what these creatures were like." It may be explained that the Theromorpha, or Anomodontia, are those extinct reptiles so common in the early secondary deposits of South Africa, some of which present a remarkable resemblance in their dentition and skeleton to mammals, while others come equally near amphibians.

As the result of his explorations in North-Eastern and Eastern Africa, Mr. Oscar Neumann has been able to determine a number of new species, including a guereza and several other monkeys, a jackal which he names *Canis kaffensis*, a harnessed antelope called, in honour of the Emperor of Abyssinia, *Tragelaphus meneliki*, together with several other members of the same group, and two "dassies," or hyraces (*Procavia*). The descriptions are published in Nos. 3, 4, and 9 of the *Sitzungs-Berichte* of the Berlin Naturalists' Society for the present year.

Mr. O. Thomas, of the British Museum, in the June number of the *Annals of Natural History* is able to announce that at least three local forms of that remarkable animal the African hunting-dog (*Lycaon pictus*) can now be recognised, namely the typical Mozambique race, the Cape race, and the Eastern race. As showing the absolute necessity of having large series of specimens of animals in our museums, the following remarks of the author are worth quotation: "Owing to their peculiar irregular coloration," he writes, "specimens of *Lycaon* are particularly difficult to compare effectively with one another, and still more to describe in an effectual manner. As is well known, no two individuals, even if from the same pack, are precisely identical, and it is only by the general average coloration that one is able to distinguish the local races at all."

British Ornithological Notes.

Conducted by W. P. PYCRAFT, A.L.S., F.Z.S., M.B.O.U.

WILD BIRDS' PROTECTION ACTS.—The *Field*, June 21st, contains some interesting comments on the numerous amendments to these most salutary Acts, amendments which, it must be admitted, though framed with the best intentions, have not always been wise, and have not infrequently failed to effect the object aimed at. The latest amendment is contained in a Bill introduced by Lord Jersey, and passed through the third reading in the House of Lords during the second week in June. According to this Bill, any person convicted of an offence against the Wild Birds' Protection Acts, 1880–93, may be condemned by the Court, in addition to the penalty imposed, to forfeit any wild bird, or wild birds' eggs, in respect to which the penalty was imposed. The forfeited property is to be disposed of as the Court may think fit. The need of such an Act has long been felt. Hitherto, in the case of rare birds or their eggs, the fine imposed acted by no means as a deterrent, forming, as it did, but a small fraction of the value of the specimens now to be confiscated.

ACQUIRED HABITS IN WILD BIRDS.—Mr. W. B. Tegetmeier, in the *Field* of June 28th, makes a few observations on certain "acquired habits" in the Sparrow,

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Rook, Titmice, Thrushes and Starlings. Some of Mr. Tegetmeier's remarks caused us some surprise and not a little sorrow, but perhaps we have taken them too seriously. We feel certain that his remarks concerning the value of birds as insect destroyers are not supported by fact, and are calculated to do some harm—perhaps much harm.

ABRUPT VARIATION IN INDIAN BIRDS.—Mr. Frank Finn, in the *Journal of the Asiatic Society of Bengal*, Vol. LXXI., part II., 1902, contributes some interesting observations on albinistic variations. The most noteworthy of these are furnished by the Ruff (*Pavoncella pugnax*). In a considerable number of specimens, mostly males, Mr. Finn finds the winter plumage characterized by a white head, and white mottlings in the body plumage. Since this variation occurs only in old birds, Mr. Finn is inclined to regard it as a species of senile albinism. Some strong and vigorous birds, however, also appear in this white-mottled and white-headed guise, and in consequence the author seems to change his view of the significance of the variation, and to hold that it is a well-marked and definable form, liable to recur again and again. Such recurrent aberrations, he thinks, it is desirable to distinguish by a sub-specific name, proposing therefor *Pavoncella pugnax lecoprora*. Important, and in every way worthy of record such variations certainly are, but we venture to doubt whether the bestowal of specific names on such forms is justified.

White-fronted Goose Nesting in Captivity.—Mr. F. W. Frohawk, in a letter to the *Field*, July 5th, records perhaps the only authenticated instance of this bird breeding in confinement. The pair of birds which have achieved this fame belonged to Mr. J. S. Green, of Blackheath. Five eggs were laid, but of these only one has hatched out. It is to be hoped that the gosling will reach maturity.

Rheas Breeding in Captivity.—Major Fothergill, in the *Avicultural Magazine* for May, records some extremely interesting facts about the nesting habits of the Rheas in his possession. We are much tempted to quote therefrom, but space forbids.

Noteworthy additions at the Zoological Gardens.—We draw the attention of our readers to the fact that three specimens of Darwin's Rhea, six ruddy Flamingoes, and a Great Bird of Paradise *(Paradisea apoda)* have recently been added to the Society's collection. All are in good health, and well worth a visit.

All contributions to the column, either in the way of notes or photographs, should be forwarded to W. P. PYCRAFT, *at the Natural History Museum, Cromwell Road, London, S.W.*

Notices of Books.

"EXPERIMENTAL CHEMISTRY." By Dr. L. C. Newell. Pp. xv. and 410. (London: D. C. Heath.) Illustrated. 5s. Text-books of chemistry are so numerous that a new one is apt to be regarded with the same mixed feelings which the father of a large family receives the news of the advent of another little stranger. But to pursue the analogy, though there is a strong family likeness between the various volumes, each possesses some peculiar characteristics, which may or may not be desirable. The most original feature of Dr. Newell's book is due to the combination of the inductive and deductive methods of teaching. The book contains an enlightened course of practical work as well as a descriptive account of chemical principles and philosophy. It is thus a laboratory manual and a text-book combined; and we know of few books in which the combination is more successfully performed. Usually the experiments described in class-room books are suitable only for the purpose of lecture demonstration, but in the present volume they are of the simple character required for individual work in the laboratory. There are, in addition, practical exercises bearing upon the laboratory work, problems on the calculation of results from given data, and subjects for short descriptive essays. The student who follows such a course of manual and mental work as Dr. Newell provides will derive permanent benefit from it, and the teacher who uses the book will find his work inspired as well as facilitated. The only objection to the wide adoption of the book in this country is the American orthography in such words as "meter," "liter," "color," &c.

"MAMMALIA" (Cambridge Natural History, Vol. X.). By F. E. Beddard. (London: Macmillan & Co., Ltd.) Pp. xii. and 605. Illustrated. 17s.—In this volume Mr. Beddard has undoubtedly made an important contribution to the history of mammals, his text-book being the only one which can be said to be up to date and to contain notices of the many important types—both recent and fossil—discovered during the last few years. Since the author is an anatomist rather than a systematist, it would be natural to expect that his work should deal with the subject more from the morphological than from the taxonomic aspect, and a glance at the volume will show that this is really the case. Of special importance and interest is the large amount of space devoted to the characters and structure of the brain in the different groups, since this is a subject the author has made specially his own, while it is also one to which but scant attention is generally paid in works of this nature. Another feature worthy of the highest praise is the importance accorded to extinct types, especially since Mr. Beddard is not himself a palæontologist. His morphological studies of the group have, however, evidently led him to conclude that it is quite impossible to arrive at any true conception of the relations of the existing forms without taking into consideration their extinct forerunners. In this part of his subject the author is fortunate in having received much valuable assistance from such a competent authority as Prof. H. F. Osborn, of New York. We have said that Mr. Beddard is not primarily a systematist, nevertheless he is thoroughly up to date, if not indeed in advance of some of his contemporaries, in dividing mammals into two (instead of three) primary groups, namely, into those which lay eggs and those which give birth to living young. In this he is undoubtedly right. Naturally, a large (perhaps disproportionately large) amount of space is allotted to the Cetacea, which have for some years attracted much of the author's attention. In the systematic treatment of some of the other orders, notably the Ungulata, there are, unfortunately, a considerable number of errors and misstatements, which it may be hoped will be remedied in a second edition. In most respects, the work is well worthy of the author, and of the series of which it forms a part.

"OTHER WORLDS: THEIR NATURE, POSSIBILITIES, AND HABITABILITY IN THE LIGHT OF THE LATEST DISCOVERIES." By Garrett P. Serviss. (London: Hirschfeld Bros., Limited, 13, Furnival Street, Holborn, E.C. 1902.)—"The point of view of this book is human interest in the other worlds around us." The subject has been often treated, frequently from the standpoint of fiction, less often from that of fact, and Mr. Serviss confines his imagination strictly to the possibilities permitted by facts when discussing the interesting probabilities and theories that have commanded wide popular attention. And we would like to make mention here of the charm and lucidity of Mr. Serviss's style; so simple and clear is the expression of his idea, that we almost lose sight of the depth and science of matters he treats of. On the road from one of our sister planets to another, with his guide book in hand, the wayfaring man though a fool may not err therein. His premisses for habitability may be very briefly described as follows: When the earth cooled and solidified out of the primeval nebula, there lay between the huge inert globe of permanently combined elements below and the equally unchanging realm of ether above, a thin shell (the surface of the crust of the earth, the lower and denser strata of the atmosphere, and the film of water that constitutes the oceans) whereon took place ceaseless combinations and re-combinations of chemical elements in unstable and temporary union, and in this shell life appeared, and only in this shell do we know of life's existence. Air and water furnish the means for the continual transformations by which the bodies of plants and animals are built up and afterwards disintegrated, and we are compelled to regard such a shell as we have on the earth, and containing air and water, or their analogues, as pre-requisites to the existence on any planet of organic life; and Mr. Serviss also includes the active stimulus of sunshine. Judging by this standard, the only habitable globes beside the earth are Venus and Mars; Mercury is in the last degree doubtful as a fit place for habitation; the moon is certainly past use; and the asteroids were never habitable; and Jupiter, Saturn, Uranus, and Neptune are not yet out of the builder's hands, so to speak. Of the satellites of these four outer planets we do not know enough to say one way or the other. The sun is not discussed; its temperature has

risen above the destructive point, beyond which our experience teaches us that no organic life can exist. But "habitable" is not synonymous with "inhabited," and Mr. Serviss wisely leaves on one side the question of the nature and form of the inhabitants of other worlds, if such exist. In only one little whimsical sketch, called "A Waif of Space,' does he give free rein to his imagination and describe a giant denizen of the minor planet Menippe. It is perhaps not quite fair to object to the description as "not necessarily being true to life" of an individual that he has expressly told us can have no veritable existence, but we think that he is generalising rashly when he describes the aforesaid individual as being three-quarters of a mile high. As we have said before, we can only know and study the laws of life on this earth, an oblate spheroid whose equatorial diameter is about 7926 miles, and whose polar is 7899. Now it would never enter our heads to attempt to deduce the latitude of a man's home from his height; we are very far indeed from finding that the sons of Anak congregate round the pole; nay, we cannot find that anywhere is the scale of men influenced by the locality. In equatorial Africa two races live side by side, and the average height of one is almost double the average height of the other, that is to say, the bulk of the giant man is some eight times the bulk of the pigmy. Had we half-a-dozen worlds to study, and the means of making a comparison of the scales on which all their elephants, and all their men, and all their ants are built, we might find some law connecting them with the diameter of their world, but as it is, with but one poor earth to reason from, there is not enough evidence to go before a jury. Having described the probable physical conditions of the planets, Mr. Serviss concludes his book by a very useful chapter on "How to find the Planets," which is illustrated by charts showing naked-eye stars near which the planets may pass in their course round the ecliptic.

"CIRCULAR NO. 9 OF THE ASTROGRAPHIC CONFERENCE."—A considerable amount of literature is gathering round the work of the Astrographic Chart and Catalogue; the present Memoir is chiefly from the pen of M. Loewy and is for the purpose of establishing the true correlation that exists between the relative positions of the stellar images on the plates, and of the corresponding stars in the sky. In the course of the investigation the following points have become evident:—In every plate, whatever its diversity of exposure, the two feeblest magnitudes of stars photographed only correspond imperfectly, both in brightness and position, with the corresponding celestial objects. The error of position is more notable than that which results from the operation of measuring, and is due to the imperfect sensibility of the gelatine to the feeblest beams of light. Star trails do not give rise to any special error, but the source of uncertainty mentioned above holds good for the faintest trails just as for the faintest star discs. When the images of a multiple exposure lie along a co-ordinate, the errors affecting the other co-ordinate are much more notable than for that passing through the line of images. The accuracy of the measures of the second co-ordinate is not increased by utilising more images. From the point of view of precision the weight to be attached to measures along the first co-ordinate is double that of the second. To render the precision of the measures homogeneous in the two co-ordinates, the line joining the stellar discs of a multiple exposure should bisect the angle between the co-ordinates. M. Loewy is also of opinion that the elongation of the images towards the borders of the plate does not affect the accuracy of their measurement, at least in stars above the limit of sensibility on the plate. In the preface, M. Loewy refutes the argument of Mr. Plummer and Mr. Hinks that systematic errors will be eliminated if the plates are measured in two positions differing by an angle of 180°. A notable systematic error is evident if the measures be compared which are taken in positions of the plate at $\frac{0^\circ+180^\circ}{2}$ and $\frac{0^\circ+270^\circ}{2}$ as he shows in the third Memoir of the present Circular.

"OCCULTATIONS OF STARS AND SOLAR ECLIPSES." By F. C. Penrose. Second Edition. (London: Macmillan & Co., Ltd. 1902).—The first edition of Mr. Penrose's most valuable work appeared in 1869, and in the present issue the work has been much condensed and simplified as well as partially extended, especially in the case of total solar eclipses. Thus the conditions of totality for the total solar eclipse of January 22, 1898, as seen at Sahdol, in India, is one of the new diagrams.

BOOKS RECEIVED.

Dictionary of Photography. By E. J. Wall, F.R.P.S. (Hazell, Watson & Viney.) Illustrated. 7s. 6d net.

Gentle Art of Book Lending. By George Somes Layard. (Malvern Federated Library.)

First Stage Mathematics (Organised Science Series). Edited by William Briggs. (University Tutorial Press.) 2s.

Year Book of Photography and Amateurs' Guide, 1902. (*Photographic News* Office.) 1s net.

Plant Physiology. By William F. Ganong, PH.D. (Bell.) Illustrated. 5s. net.

Injurious and Useful Insects. By L. C. Miall, F.R.S. (Bell.) Illustrated. 3s. 6d.

Metallography. By Arthur H. Hiorns. (Macmillan.) Illustrated. 6s.

Studies in Heterogenesis. Second Part. By H. Charlton Bastian, M.A., M.D., F.R.S. (Williams & Norgate.) Illustrated. 7s. 6d.

Watkins' Manual of Exposure and Development. By Alfred Watkins. (Houghton.) 1s. net.

Bulletins of the University of Kansas. Vol. IX., Nos. 1, 2, 3, 4, and Vol. X., Nos. 1, 2, 3. (Kansas University.)

Chaldean Astrology Up to Date. By George Wilde. (Marsh-Stiles.) 7s. 6d.

Mining in Rhodesia. (British South Africa Company.)

Meteorological Observations for 1901. (Rousdon Observatory.)

Zoological Gardens, Ghizeh, near Cairo: Report for the Year 1901. By Stanley S. Flower. (Cairo: National Printing Department.)

Process Photogram. July, 1902. 6d.

New Phytologist. Vol. I., No. 6. 1s. 6d.

Preparation of the Earth for Man's Abode By J. Logan Lobley, F.G.S., F.R.G.S. (Victoria Institute Transactions.)

Scientific Roll. By Alexander Ramsay. (R. L Sharland.) 1s.

Memorias y Revista de la Sociedad Científica "Antonio Alzate." XIII., Nos. 3 and 4; XVI., Nos. 2 and 3.

Catalogue of Max Kohl, Chemnitz. (Isenthal & Co., sole agents for the United Kingdom and its colonies.)

Abridged Catalogue, 1902. (Ross, Limited, 111, New Bond Street.)

Catalogue of Photographic Apparatus. (Sanders & Crowhurst, 71, Shaftesbury Avenue.)

Catalogue No. 2. "Philosophical Apparatus." (Newton & Co.)

THE NOBODIES,—A SEA-FARING FAMILY.

By the Rev. T. R. R. STEBBING, M.A., F.R.S., V.P.L.S, F.Z.S.

CHAPTER IV.

IF the Pycnogonida have, comparatively speaking, no bodies and with an inconsiderate world no flaunting reputation, they are by this time fully freed from the hardship of having no names. With these they have been abundantly blessed, though, when the names are attended by definitions that leave them altogether indefinite, the blessing is very much in disguise. More than forty genera have been nominally established, but some of them so obscurely that now and then a desperate author pounds up eight or nine into one. Then again the counsels of despair have to be modified, and some of the rejected names resume their place in the system.

There is, as naturalists are aware, a continual strife being waged over classification. The philosopher is here at one with the many. He desires and demands the natural, the best, the permanent. The working zoologist supplies only the imperfect and the transitory, based on a disgraceful neglect of all those features and conditions which at the time he happens to know nothing about. His patient toil, his gradual acquisition of knowledge and insight, bring him into more discredit. For he changes his system to embrace the new facts, and with his old perversity does not include in it the unknown and the unsuspected. The history of the Pycnogonida is instructive as showing that "all the talents," though they may include industry, perspicacity, imagination, genius, are incapable of producing a perfect classification until the globe has been ransacked for materials and until the materials themselves have been ransacked for informing guidance.

It has been already noted that the Pycnogonida are

XUM

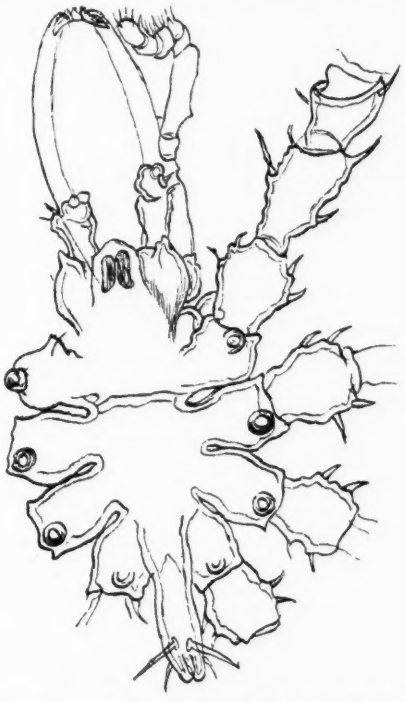
exclusively marine. An exception might be suspected in *Pallenopsis fluminensis* (Kröyer), which owes its specific name to the word Rio, a river, but Kröyer, who gave the name, explicitly states that the species was taken in the sea, in the nautical roadstead of Rio Janeiro. Future researches may find isolated members of the group living in fresh water or on dry land, but in the meantime the waters of the ocean, with their depths and shallows, straits and inlets, and the space between tide-marks along the curves and indentures of an almost immeasurable coast-line, offer a hunting-ground not likely to be soon exhausted. In particular localities of this vast field some species are said to be common or very abundant. Some species are widely distributed. Speaking of them as a group Dr. Dohrn says that "they belong to the most frequent animal forms included in the shore-fauna of all seas: you can scarcely examine a handful of sea-weeds, a few fragments of submarine gravel, or materials from the hauling of a dredge, without lighting upon one or more species of these little creatures." Still, as a rule, they seem to be a feeble and scattered folk, and yet, though their numbers are relatively few, they easily fall into the hands of the collector. An explanation of this may be suggested. In spite of their long legs they have no speed of motion, nor do they, like many children of the sea, practise varied tricks of evasiveness. Interference will induce them to crumple up their many-jointed limbs, but will not provoke them to show fight, for which they are poorly endowed. One may infer from all this that their enemies are not numerous or pertinacious. Man has been neglectful. Other devourers may have found by experience that there was no satisfactory nutriment in their long branching tubes of chitinous, or as Eights calls it "pergamineous" integument. They won't fatten. Nevertheless, like other animals, they have obeyed some stimulus impelling them to vary. Assuming that all are traceable to a common ancestor, we may ask which of the existing species are nearest to the original form, or which are the most remote from it. As so often happens in genealogies, there is a deplorable want of trustworthy documents. Fossils at present give no assistance. The larval stages cannot be expected to speak with other than a lisping voice. Existing species must be compared and cross-examined, and even then the antiquity of common characters is rendered uncertain by the chance that some may have been independently developed more than once, or have come again into evidence after a period of disappearance.

If we are searching not for the most but for the least characteristic genus, some authors not unreasonably direct our attention to *Pycnogonum*. It was a singular fate which brought this first into scientific notice, gave to this first a technically valid name and thus made it the premier genus of the group. For instead of being a good representative, it appears to have gathered about it as many exceptional attributes as it could. Most of the Pycnogonida have very slender bodies and very long legs. *Pycnogonum* delights to have the body stout and the legs rather stumpy. All the other genera find space within the body for a heart. *Pycnogonum*, in which the body is more than usually roomy, goes without one. Commonly the eggs when laid are divided between the two ovigerous legs of the male; in *Pycnogonum* both these legs are used for carrying a single egg-clump. The normal complement of limbs in the Pycnogonida, as we have seen, is seven pairs; *Pycnogonum* belongs to the anomalous section which exhibits only five pairs in the male and no more than four in the female. It has been heretofore explained how this genus flies in the face of custom by having no genital openings in the second joint of any but the last pair of legs, and there it has them sometimes contrary to usage in the upper instead of the lower surface of the joint. It goes further, and conspires with one other genus, Dohrn's *Barana*, to flout the speciality of its tribe by developing ova not only along the legs but also in the body.

Pycnogonum littorale (Ström) ♀. From Sars.

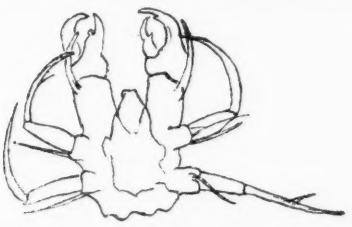
It might be argued that the characters displayed in *Pycnogonum* are primitive, and that the contrasted genera have in these respects departed from the earlier type. It is almost certain, for instance, that, before the expedient of developing ova in the legs came into play, the normal method of developing them in the body will have been followed by many an ancestress of the tribe. On the other hand that normal method may have fallen into disuse and after a long interval been revived. That the genital openings were originally a single pair is at least conceivable, but again it would not follow that the singleness in *Pycnogonum* must be regarded as original. To believe that females without the first three pairs of appendages are of an earlier type than those which have them would require a very robust faith. It would imply that the ovigerous function of the third pair in the males was primitive, whereas it is much more likely that this function was transferred from the females, and that the egg-bearing sex suffered loss of the egg-carrying limbs owing to disuse. Still more decisively is the view that *Pycnogonum* has had losses rather than that the other genera have had gains, supported by the facts connected with the first pair of appendages. These are wanting in adults of both sexes not only of *Pycnogonum* but of various other genera, and in many are found to be small and rudimentary. But, as explained in the preceding chapter, the larval forms all have these appendages, and, more than that, they all have them chelate. It would be difficult, therefore, to resist the inference that this pair at least is an original part of the organism. The circumstance that in some instances it dwindles and loses its chelate character in the adult, without disappearing altogether, gave rise to a very natural mistake. A genus *Ammothea* was founded by Leach on the young, and subsequently a genus *Achelia* by Hodge on the full-grown specimens of congeneric species, and these two genera, which are really one and the same genus, were even recently and by an approved author placed in separate families. It is no reproach to the systematist that he should fall into such errors while feeling his way towards a natural classification. The hand of man is a structure to which the human race is so incalculably indebted for

its elevation above all other animals that, if a tribe were discovered in which each arm ended in a solid stump instead of fingers, there would no doubt be little temptation to consider it human. Yet, if it proved that the infants had thumbs and fingers like our own, it might be equally difficult to classify the offspring apart from ourselves or the parents apart from their offspring. But the young *Ammothea* is just in this position. To begin



Ammothea magnirostris, Dohrn. ♂. Only basal joints shown of hinder legs. From Dohrn.

with it possesses the grasping chelæ stretched in front of its mouth. Then, with advancing life it sacrifices this advantage, first allowing the claws to occupy a seemingly quite ineffective situation to the rear of the mouth, and



Ammothea magnirostris, Dohrn. Minute larva greatly magnified. From Dohrn.

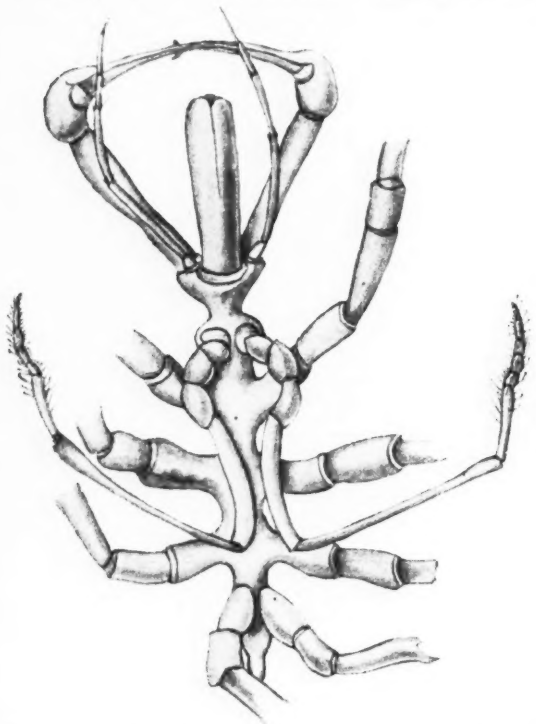
finally relinquishing their chelate character which in such a situation had ceased to be of value.

So fundamental is the importance of the chelate first appendages in the opinion of Professor G. O. Sars, that upon them he bases the primary division of the whole group into three orders or sections. Leach in earlier days on the same principle bisected it into the Gnathonia and Agnathonia. Fuller knowledge now requires a tripartite arrangement. Thus the Achelata are entirely without "chelifori" except in the larval condition. The Euchelata retain them throughout life. The Cryptochelata have them in the larval and young stages of their existence, but as adults lose them altogether or keep them only in a rudimentary state. To the first section Sars assigns two families, and three to each of the others. The Achelata comprise the Pycnogonidæ and the Chilophoxidæ, each with a single genus, and both agreeing in the absence not only of the first appendages but also of the second, the female sex wanting the third likewise. They differ because *Pycnogonum*, the representative of the first family, stands almost alone in the restricted number of the genital openings. *Chilophoxus*, for which the second family is instituted, has these apertures in all the ambulatory legs of the female and in the last three pairs of the male.* Moreover, while *Pycnogonum* has a certain portliness, which gives its typical species a claim to be somebody among nobodies just as the one-eyed man is a king among the blind, *Chilophoxus* on the contrary has nothing to show but attenuated personalities. The typical species of this latter genus is among the earlier known forms, having been described by Montagu in a paper which was read at the Linnean Society in 1805 and published in 1808. Montagu was under the impression, shared as we know by many distinguished naturalists long after him, that the ovigerous legs belonged to the female. He correctly describes the position of the four eyes on their conical tubercle, but adds that they "appear under a microscope strongly reticulated." This would seem to have been an ocular delusion on his part, for although the modern method of section-cutting has revealed a reticular tissue within the eye, such an observation would have been unattainable by any implements at Colonel Montagu's disposal. He also remarks that "on the back between the hinder pair of legs is an erect cylindric tubercle, which in some point of view might be mistaken for a tail." Tail is an indefinite word or one might wonder where the mistake comes in, for, if the part of the body which follows the ambulatory limbs may indifferently be spoken of as the abdomen or tail in crustaceans, insects, and scorpions, those expressions will be equally appropriate for the cylindric tubercle of which Montagu is speaking.

Not without some fear of evoking those electric flashes that are ever ready to smite the rash disturbers of long accepted terminology, I must here invite the special attention of naturalists to the new names *Chilophoxus* and Chilophoxidæ, and to the cancelling of the names Pallenidæ and *Pseudopallene* in favour respectively of Phoxichilidæ and *Phoxichilus*. This last-named genus was instituted by Latreille in the "Nouveau Dictionnaire d'Histoire Naturelle," tom. 24, p. 137, so far back as 1804, not as has been stated in 1816. The only species assigned to it was the *Pycnogonum spinipes* of O. Fabricius. It is impossible therefore to retain *Phoxichilus* apart from that species. Consequently *Pseudopallene*, Wilson, 1878, to which both Sars and Meinert refer the above-named *P. spinipes* of the "Fauna Groenlandica," becomes a synonym of Latreille's far earlier genus, and the family hitherto known as Pallenidæ, from *Pallene*, Goodsir, 1837, must be henceforward known as Phoxichilidæ. All species which have been assigned to *Phoxichilus* on the ground of a real generic agreement with Montagu's *Phalangium spinosum* must now be transferred along with this species to *Chilophoxus*, while *Pseudopallene circularis* (Goodsir) will find its place in the true *Phoxichilus* as now reinstated.

* Mr. Marshall's paper "On variation in the number and arrangement of the male genital apertures in the Norway Lobster" (*Proc. Zool. Soc. London*, 1902), is worth considering in connection with our subject, but with the crustacean it is an increase in the number of openings that is exceptional, whereas in the Pycnogonida it is the diminution in their number that calls for remark.

The Euchelata comprise three families which all have the first appendages well developed but vary in regard to the second. These are wanting in the Phoxichilidiidæ, small or rudimentary in the Phoxichilidæ, and only five-to-seven-jointed in the Nymphonidae. The first of these

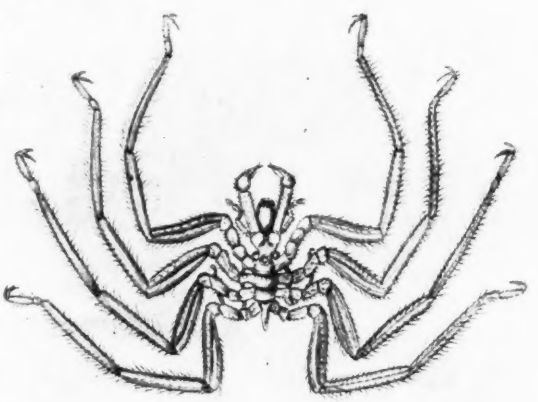


Nymphon hamatum, Hoek, ♂. Ventral view, legs only partially shown. From Hoek.

families has a further link with the preceding section in that the females are without the ovigerous legs. Among other genera it contains one to which the eccentric French naturalist Eugène Hesse applied the name *Oomerus*, meaning "eggs in the thighs." As Goldsmith said of Edmund Burke that he "gave to a party what was meant for mankind," so here the French writer allots to a single genus a term that fits all the Pycnogonida. Very probably his ill-defined genus is not distinct from the earlier *Phoxichilidium*, Milne-Edwards, 1840, from which Wilson, in 1878, separated *Anoplodactylus*, itself perhaps identical with *Anaphia*, Say, 1821. In *Phoxichilidium* the peculiarity has been noticed that the young become parasitic on zoophytes. *Anoplodactylus* by its name, meaning "unarmed finger," alludes to a supposed contrast between this genus and that from which it was detached. The ambulatory legs in *Phoxichilidium* have a powerful finger or claw, on the back of which close to the base are a pair of auxiliary claws, small but conspicuous. A species which seemed to be without these accessories was on that account transferred to *Anoplodactylus*, but now in turn Sars has shown that the auxiliary claws are actually present in the new genus as well as the old, though so small and feeble as scarcely to deserve the title of weapons.

Of the Phoxichilidiidæ some illustrations have been given in earlier chapters. To it belong, in addition to genera already mentioned, *Pseudopallene*, Wilson, 1878, *Hannonia*, Hoek, 1881, *Neopallene*, Dohrn, 1881, *Cordylochele*, Sars, 1888, and *Parapallene*, Carpenter, 1892.

The Nymphonidæ are interesting in various ways. As already explained, *Nymphon marinum* (Ström) is the earliest recorded species. *Nymphon*, Fabricius, 1794, is the earliest genus but one, and includes a greater number of species than any of the other genera. Some of the forms comprised in it, though not actually the largest, are among the largest known. With one exception, representatives of it reach the greatest depths in the ocean attained by any of this group, descending a long way below two thousand fathoms, so as to be separated from the upper air by a thickness of two and a half miles of water. The species figured was dredged up from one thousand six hundred fathoms in the Southern Ocean. Ström's *N. marinum* is one of six species of the genus found in British waters. This was re-described by Harry Goodsir in 1845 as *N. giganteum*, from Northumberland. He gives the span of it as six inches, equivalent to one hundred and fifty millimetres. Other authorities give the length of the body as three-fifths of an inch or fifteen millimetres, so that the legs are nearly five times as long as the body. But that this giant is not very corpulent is shown by a further minute calculation which Kröyer supplies. He reckons that the legs are about sixty times as long as the breadth of their fourth joint, which no doubt he chooses as being the limb's broadest part Till recently a seventh British species of this genus might have been counted, but Goodsir's *N. spinosum* has now been transferred by Sars to a new genus *Chætonymphon*, "the hairy Nymphon." This designation alludes to a characteristic which had been noted in three species, respectively named on that account *hirtum*, *hirtipes*, and *spinosum* (shaggy, shaggy-foot, and thorny), by Fabricius, Bell, and Goodsir. Besides five northern species this genus contains one from the chill southern waters of Kerguelen Island. The hairiness of this sub-antarctic form is attested by the name *hispidum* given it by Hoek in 1881, and by the earlier *horridum* given it by Böhm in 1879. But, let the species be as rugged as a bear, as bristly as the fretful porcupine, it cannot retain either of these names, for it has proved to be an acquisition made by the Antarctic Expedition under Sir James Ross when, visiting Kerguelen in May and June, 1840, an acquisition



Chætonymphon spinosum (Goodsir)?. After Sars.

which had lain in our national collection unnamed and unregarded until a preliminary description of it as *Nymphon brevicaudatum* was published by Miers in 1875. For the Arctic species named by Bell *Nymphon robustum*, Sars has founded the genus *Boreonymphon*, "the boreal

Nymphon." This may apparently be considered as just coming within the British area of marine zoology, since on the cruise of the "Knight Errant" it was taken at a great depth to the north of Scotland but as far south as latitude 60°. Sir John Murray, of the "Challenger," writing to Dr. Hoek, informed him that the immense number of specimens of this species obtained on that occasion was the largest haul of Pycnogonida he had ever seen—about a thousand specimens. Sars, when explaining his motive for instituting the genus, observes, "the peculiar circumstance that the young continue to remain firmly adherent to the body of the male, even after they have attained more than half the definite size, is also remarked among the generic characters, as a similar relation, so far as I am aware, has not been found in any other Pycnogonid." Another genus, *Paranymphon*, with seven joints instead of five to the second appendages, was founded by Caullery in 1896 for a species from considerable depths in the Bay of Biscay. The same species has since been found also in high northern latitudes. Like *Boreonymphon robustum* it is blind.

The genus *Decolopoda*, Eights, 1837, requires either an additional family Decolopodidæ, or a widening of the definition of the Nymphonidæ, for its second pair of appendages are ten-jointed. The typical species *D. australis* was taken in the vicinity of the New South-Shetland Islands. Its chelifori are large with much curved thumb and finger. Of the many specimens obtained all were provided with ovigerous limbs, eleven-jointed, so that Eights counted these in with the four following pairs of legs, and framed a generic name which signifies that in this form there are "ten perfect feet." "The entire animal," he says, "is of a bright scarlet." With this gay picture to contemplate, we may conveniently pause before attempting a survey of the Cryptochelata.

Conducted by M. I. Cross.

Pond-life Collecting in August.—For the collector of Cyclops, Diaptomus, Waterfleas, and aquatic insect larvæ, August is a very capital month; not so, however, for the collector of the more interesting Infusoria and Rotifera, which are usually quite crowded out by the more vigorous crustaceans in the few remaining ponds and pools not wholly dried up. In larger lakes, however, it is possible to find occasionally a number of interesting forms, particularly free-swimming Rotifers such as *Asplanchna priodonta* and *brightwelli*, *Synchæta pectinata* and the rarer summer forms: *Synchæta stylata* and *grandis*. Where a "green" pond can be found, full of the flagellate Infusorian *Euglena viridis*, there are usually present also a number of Rotifers such as *Hydatina senta*, *Eosphora aurita*, *Diglena biraphis*, etc., feeding on the Euglena.

In shady forest pools, overgrown with Sphagnum, quite a peculiar fauna of Moss-haunting Rotifers will be found, particularly various species of *Callidina*, *Distyla*, *Metopidia*, *Cathypna*, in addition to numerous interesting Rhizopods with shells of various forms. In similar ponds the large, but very rare, Rotifer *Copeus spicatus* should be looked for. Of other Rotifers that may be met with in lakes, more or less abundantly, the following can be mentioned: *Brachionus pala*; *Anuræa aculeata*, *brevispina* and *hypelasma*; *Dinocharis poculum*; *Euchlanis triquetra*, *hyalina* and *oropha*; *Mastigocerca bicornis*, *elongata* and *stylata*; *Polyarthra platyptera*; *Synchaeta tremula* and *oblonga*; *Pedalion mirum*; and many others.

Apochromatism and other terms.—So much confusion seems to exist, even at this day, as to what is understood by the term "apochromatism," that it may be well to express, in as intelligible a form as possible, the essential qualities which are properly associated with this name, and the difference that exists between it and semi-apochromatism and achromatism.

Apochromatism is an expression of the highest attainable correction of microscope objectives, comprising the correction of spherical aberration for all colours and the union of three different colours in one focus, that is, elimination of the secondary spectrum.

Semi-apochromatism may be defined as combining such qualities that the spherical aberration is corrected practically for all colours. It will be understood that in this case the secondary spectrum is present.

An *achromatic* microscope objective, pure and simple, is one in which, as a rule, defects worse than the secondary spectrum are caused by spherical aberration of the coloured rays, the spherical aberration being corrected for the brightest part of the spectrum only. Generally in this correction two different colours only are united in the same focal point.

In order that a clear conception may be formed of the above remarks, it will be well to append a brief explanation of the *Secondary Spectrum*. In an achromatic lens the chromatic aberration is corrected for the brightest (yellow and green) rays of the spectrum, and the pronounced colour shown by uncorrected lenses is, in consequence, removed.

A stricter examination, however, shows that rays of a different colour are not brought to the same focus, for, owing to the fact that flint glass, as compared with crown glass, disperses the more refrangible rays relatively too much, and the least refrangible relatively too little, a peculiar *secondary* spectrum results from the achromatic combination, the rays corresponding to the brightest apple-green part of the ordinary spectrum being very closely united and focussed nearest the combination, whilst the other colours focus at increasing distances *in pairs*, yellow being united with dark green, orange with blue, red with indigo. The composite effect of these colours is best seen with oblique light, causing dark objects to have apple-green borders on one side and purple ones on the other.

Preparation of Metal Specimens for the Microscope.—In Knowledge for November, 1901, reference was made to the microscopic examination of metals in general terms, and as some considerable interest was evinced in the subject, the following notes have been prepared to guide those who may wish to experiment for themselves in the preparation of metal specimens for examination.

The preparation of specimens of metal for the microscope involves the greatest care; the principal object being to obtain a perfectly level surface, free from all scratches and marks, with the highest degree of polish. This will be better illustrated by an example.

The student having obtained a sample of metal, the first thing to do is to carefully file or grind the surfaces he wishes to examine. The marks thus made must be taken out with a very smooth file or emery cloth, gradually diminishing the coarseness of the cloth until he reaches the finest grade of all.

From this stage the polishing must be done on parchment or chamois leather stretched very tightly on wood: the leather being covered with fine crocus powder or rouge moistened with a little water.

This is the most important stage of the specimen, especially if the metal be very soft, and the student should frequently examine the metal through the microscope—a matter of a few moments only—by clamping it in one of the new metal holders which have been recently introduced by Messrs. R. & J. Beck and Watson & Sons. These holders are fitted with jaws in which the subject is firmly gripped, and provide for setting in any plane, and obviate the necessity for mounting the specimens on glass slips.

On examination it will be seen that parts stand in very high relief. This is the object of the leather polishing—to gradually grind away the soft and leave the hard parts, and great care should be exercised.

Having obtained the requisite degree of polish the specimen

XUM

is now ready for further treatment, viz.: etching. The object of this is to further develop the structure.

Etching is done by means of various reagents, the choice of which is mainly a matter of personal opinion, but perhaps the most generally used, and the best for beginners, are infusion of liquorice root and tincture of iodine. Very dilute nitric acid and sulphuric acid are also used, but until the student has become thoroughly acquainted with the effects of the above he is not advised to use them.

Before proceeding further it is advisable to give an outline respecting the effects of the reagents, also the construction of the metal.

Steel is viewed as if it were a rock with various constituents in it. There are three principal ones, viz.: Ferrite, Cementite, and Pearlite (or Sorbite).

Ferrite:—This is free from carbon; it retains a very dull polish, and is not stained by iodine or liquorice. To develop the crystalline structure of Ferrite, a very dilute solution of nitric acid in alcohol should be used.

Cementite:—This is a very hard substance, and stands in relief after polishing as above. It is very rarely found in low-carbon steels, and is left bright after the polished surface is attacked by iodine.

Pearlite:—This is a very intimate mixture of Ferrite and Cementite. If the steel has been allowed to cool slowly from a very high temperature, Pearlite assumes a well-defined lamellar structure; on the contrary, if the metal has been forged, or re-heated at a very low temperature, Pearlite assumes a granular appearance. It is readily acted upon by iodine or liquorice.

From this it will be seen that steel is made up of: (1) Ferrite and Pearlite, (2) Pearlite, (3) of Pearlite and Cementite. Other constituents are found in steel after it has undergone certain treatment, but enough has been said to guide the student to make a commencement.

The method of applying the reagent is as follows:—The specimen is either coated with some protective varnish—leaving the surface free that is to be acted upon—and immersing the whole in a bath; or a few drops may be applied to the surface, and then carefully spread by means of a glass dipping rod. The solution should be allowed to act, say, for twenty seconds, then carefully washed in alcohol or methylated spirits, gently rubbing the surface with the little finger, finally washing in water, and drying with a very soft piece of linen.

The metal is now examined under the microscope, and it will then be seen if the etching has been sufficient; if not, it should be repeated as above for another twenty seconds. The student should do this several times, noting the effect of the reagent each time until he becomes thoroughly acquainted with its properties.

So far we have only dealt with steel, but alloys of tin, copper, &c., are treated in exactly the same way, with the exception that liquorice and iodine are not used. The various acids, ammonia and caustic potash, &c., are used in weak solutions as etching reagents.

With respect to the mounting of the specimens, from what has already been said regarding the new holders, it will be seen that the affixing to glass slides is no longer necessary. Where a glass slide is used a great deal of extra work is involved, because it sometimes happens that the under side of the metal is left jagged, or may be broken off at a very sharp angle, and before this could be mounted there would be a long delay in filing and grinding, also the thickness of the block of metal would have to be kept within certain limits. No consideration has to be paid to these matters when a holder is used.

Some workers bed the metal on a glass slide in modeller's wax, and then to render it quite plane attach to the microscope nose-piece an uprighting tool and bring it down on the face of the metal under examination. It will be at once seen that all this is really not needful with a clamping holder.

NOTES AND QUERIES.

Sigma.—A glycerine immersion objective cannot be so efficient as the homogeneous one, or that which is used with cedar wood oil. Glycerine has not a refractive index the same as crown glass, being only 1·47, and its dispersion is too high; moreover, its hygroscopic properties are against it. It has been practically abandoned since the superiority of cedar wood oil has been established. An air-angle of 170° would correspond to a N.A. of ·995, which is very low for an immersion lens.

J. Hills.—Presumably you wish to know the best way to keep insects that you may collect for future mounting as micro objects. If so, you cannot do better than place those with hard chitonous bodies in methylated spirit, the more delicate ones might be more satisfactorily preserved in spirit and water, half of each.

NOTE.—The Centipedes from Portugal which were offered for distribution in the June number have been identified as *Scutigera coleoptoata*, and are stated to be very fine specimens. A few of these are yet available on receipt of a stamped label and a glass collecting tube.

Communications and enquiries on Microscopical matters are cordially invited, and should be addressed to M. I. CROSS, KNOWLEDGE *Office*, 326, *High Holborn*, *W.C.*

NOTES ON COMETS AND METEORS.

By W. F. DENNING, F.R.A.S.

Jean Louis Pons, who began his comet-seeking about a century ago, must still be regarded as the most successful worker who has ever entered this field. He was born in 1761, and died in 1831. When doorkeeper at the Observatory of Marseilles he was instructed and encouraged by the Director, Thulis (the discoverer of Encke's comet at its return in 1805), to take up the search for new comets, and Pons followed the work so successfully during the 26 years from 1801, July 12, to 1827, August 26, that he independently discovered 37 comets. In several instances he was, however, anticipated by other observers, though the fact remains that during the first quarter of the 19th century he discovered nearly all the comets that were seen. During the 14 years he remained at Marseilles he picked up 18 new comets. His initial success was in 1801, July 12, but several other astronomers, including Messier, Mechain, and Bouvard, shared this discovery. It was just a century ago, namely, on 1802, August 26, that Pons could claim to have been absolutely the first discoverer of a comet. Among the more important objects he found may be mentioned the periodical comets of Biela (1805), and of Encke and Winnecke (1819). In 1812 he picked up a comet which proved to have a period of about 71 years, and belonged to the Neptune family. Pons supplied a prominent example of an individual entirely devoting himself, with an ability only matched by his diligence, to one field of observation and achieving success beyond any historical parallel, either before or after his time.

COMET 1898 I. (PERRINE).—A definitive determination of the orbit of this comet has been made by Heber D. Curtis, of Virginia. In all the comet was observed 666 times for position, and 34 different observatories participated in the work. The comet remained visible during about eight months (March 20th to November 15th), and an especially fine series of observations were secured by the discoverer, Mr. C. D. Perrine, with the 12 and 36-inch equatorials of the Lick Observatory on Mount Hamilton. From the visual estimates of the diameter of the coma, ranging from 2 minutes of arc on the date of discovery to 10 seconds of arc at the middle of November, there seems to have occurred a considerable shrinkage, the dimensions at the two periods being 84,000 miles and 12,000 miles, while the distances of the comet from the earth were 147 and 247 millions of miles respectively. The following are the definitive elements:—

Equinox of 1898·0.
P.P. = 1898 March 17·130777 G.M.T.
ω = 47° 19′ 11″·85.
Ω = 262° 26′ 19″·06.
i = 72° 31′ 47″·01.
log. q = 0·0395112.
e = 0·9803852.
Period = 417·2 ± 2·2 years.

AUGUST PERSEIDS.—During the first half of August, moonlight will offer little impediment to the visible progress of the display, and, with clear weather, it will be possible to obtain an unusually successful series of observations. There are several points in connection with this rich annual shower which require further investigation, viz.: the horary number of meteors visible, the exact position of the radiant on each night of observation, and the character of the radiation (*i.e.*, whether limited to a contracted area or diffused over a comparatively large space). Observers will also do well to record the times and apparent courses of the brighter meteors seen (especially such as are non-Perseids) so that data may be available for computing their real paths in the air. As 1900 was not leap-year the maximum number of meteors will appear on the morning of August 12 or 13. An ephemeris of the radiant, based on a large number of observations obtained in previous years, will be found in the *Monthly Notices* for December, 1901, p. 169.

FIREBALL AT NOONDAY.—An observer, writing from York, says that he was amongst the Wolds on June 28th, and at 11h. 48m. a m. saw a large meteorite travelling rapidly from east to north-east, and falling from an altitude of 40 to 20 degrees. The sun was shining in a sky almost entirely free from cloud. The meteorite exhibited a rounded head and a tail of vivid phosphorescent green colour, and it formed a conspicuous object on the deep blue of the firmament Another observer, residing at Driffield, noticed the phenomenon, and describes it as moving from the east some distance above the horizon, and looking like polished silver.

THE FACE OF THE SKY FOR AUGUST.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the sun rises at 4.24 A.M., and sets at 7.48 P.M. On the 31st he rises at 5.11 A.M., and sets at 6.49 P.M.

There is a lack of sunspots and faculæ, and indeed there is every prospect of this year, like the last, being one of an abnormal minimum.

THE MOON:—

	Phases.	h. m.
Aug. 3	● New Moon	8 17 P.M.
„ 11	☽ First Quarter	4 24 A.M.
„ 19	○ Full Moon	6 3 A.M.
„ 26	☾ Last Quarter	11 4 A.M.

The Moon is in perigee on the 1st and 29th, and in apogee on the 13th.

Occultations.—On the 10th, the bright star α Librae will suffer occultation. The following are the particulars:—

Date.	Name.	Magnitude.	Disappearance.			Reappearance.			Moon's Age.
			Mean Time.	Angle from N. Point.	Angle from Vertex.	Mean Time.	Angle from N. Point.	Angle from Vertex.	
				°	°		°	°	d. h.
Aug. 10	α^1 Librae	5·3	8 23 P.M.	132	106	9 32 P.M.	250	217	7 0
„ 10	α^2 Librae	3·0	8 41 P.M.	142	114	9 35 P.M.	239	206	7 0

THE PLANETS.—Mercury is not observable, being in superior conjunction with the sun on the 11th.

Venus is a morning star, in Gemini, and is near Mars on the 1st. The planet rises in the N.E. about $2\frac{1}{2}$ hours prior to the sun; the apparent diameter is shrinking, being now only 12″·0, whilst 0·89 of her disc is illuminated.

Mars is a morning star in Gemini. He rises in the N.E. about 1.30 A.M. The distance of the planet is so great, however, that the apparent diameter is only 4″·0, and his disc is somewhat gibbous, 0·96 being illuminated.

Jupiter is now visible from sunset to sunrise, and attracts the attention immediately on looking to the south, not very high up in the sky. About the middle of the month he is on the meridian at 11.20 P.M., whilst on the 5th the planet is in opposition to the sun, and then attains his greatest apparent diameter of 45″·0. During the month he describes a retrograde path, passing so close to θ Capricorni that the star should be seen in the same field of view as the planet on the evening of the 4th.

Observing at 11 P.M., three satellites only will be visible on the 4th, 6th, 19th, 22nd, 27th, and 29th, the other being either in transit, eclipse, or occultation, whilst on the 12th two satellites will be eclipsed, satellites II. and IV. being visible.

Saturn is in Sagittarius, and though somewhat low down is very conveniently situated for observation in the early evening; about the middle of the month he is on the meridian at 10 P.M., thus being some 20° to the west of Jupiter. On the 8th the apparent polar diameter of the planet is 17″·0, whilst the major and minor axes of the ring have diameters of 42″·5 and 16″·6 respectively, the northern surface being invisible.

Uranus is in Ophiuchus, near the star Theta in that constellation; on account of its small altitude it is scarcely discernible to the naked eye, but by the aid of the chart given in the June number, and small optical assistance, it may easily be picked out from amongst the surrounding stars. At the beginning of the month the planet souths at 8.30 P.M., whilst his apparent diameter is 3″·7; on the 27th of the month he is at the stationary point, after which his path is direct or easterly.

Neptune is a morning star in Gemini, but for all ordinary purposes is out of range.

THE STARS.—About 9 P.M. at the beginning of the month the constellations to be noticed are:—

ZENITH . Lyra (*Vega*), Hercules, Draco.
SOUTH . Sagittarius, Scorpio, Ophiuchus, Aquila; Aquarius and Capricornus to the S.E.
WEST . Boötis, Corona; Great Bear to the N.W., Virgo and Libra, S.W.
EAST . Cygnus, Delphinus, Pegasus, Aries; Andromeda and Cassiopeia to the N.E.
NORTH . Ursa Minor, Auriga (*Capella* on horizon).

Minima of Algol will occur on the 9th at 0h. 38m. A.M., 11th at 9h. 27m. P.M., and the 31st at 11h. 10m. P.M.

Chess Column.

By C. D. LOCOCK, B.A.

Communications for this column should be addressed to C. D. LOCOCK, Netherfield, Camberley, and be posted by the 10th of each month.

Solutions of July Problems.

No. 7.

The Author's key is 1. Q to R3, but 1. Q to Kt3 and 1. Q to B4 will also solve the Problem.

No. 8.

Key-move.—1. P × P.

If 1. . . . any except K to Q4, 2. Q to B5ch, etc.

[After 1. . . . K to Q4 there is a quintuple continuation by Q to B5ch or Q to B7ch or QK2, or QKsq or R × KP.]

No. 9.

Key-move.—1. Q to Bsq.

If 1. . . . Kt × Q, 2. Kt to B3ch, etc.
1. . . . Kt to Kt5 2. Q to B5ch, etc.
1. . . . P to K4, 2. Q to Q2ch, etc.
1. . . . K × R, 2. Q × Pch, etc.
1. . . . B to Q6 or P × P, 2. B to K6ch, etc.
1. . . . B to B5 or Q8, 2. Q mates.
1. . . . Any other, 2. Q × P, etc.

[There are duals after 1. . . . P to Kt4, by 2. Q × P or Q to B5ch; after 1. . . . B to Q6, by 2. Kt × Pch or B to K6ch; and after 1. . . . P × P, by the same two continuations. But as the mates are entirely different in the two last-named variations, I think that they must count as separate duals.]

SOLUTIONS received from W. Nash, 4, 5, 6; Alpha, 4, 4, 4; W. Jay, 6, 5, 7; G. Woodcock, 4, 5, 5; G. W. Middleton, 4, 5, 4; W. de P. Crousaz, 4, 5, 5; "Tamen," 6, 5, 0; C. Johnston, 6, 5, 5; "Looker-on," 6, 5, 6; A. F. (Rugby), 4, 5, 4; J. W. Dawson, 4, 4 7; H. Boyes, 4, 3, 3; H. Myers, 4, 5, 7.

XUM

H. Boyes.—In your claims for duals in Nos. 8 and 9, you have in each case apparently overlooked that the Black KP can cover the final check. In reply to your question about No. 6, after 1. Kt × Kt, P to Kt4; 2. R × R, Black defends by 2. B × P.

G. W. Middleton.—Your claim for a dual after P × P by 2. Kt to B7ch is incorrect. After 2. . . . K to Q3 there is no mate.

G. Woodcock.—Please see above. As you give three continuations after 1. . . P × P and 1. . . B to Q6, I consider that you should score one point in each case for the correct dual, and lose one point for those that are incorrect. This cancels your score as far as those two variations are concerned. You score, of course, for the dual after P to Kt4.

B. G. Laws and Dr. Hunt.—Many thanks for your help in deciding the point referred to you.

H. D'O Bernard.—Much regret your retirement for this year.

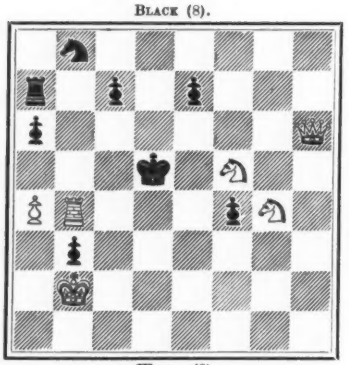
Composer of "Tubby."—I regret the slip in stating that Castling was the *key* of your problem. The move occurs as a continuation on White's second move, and, as such, is I think inadmissible in a tournament problem. It may be admissible for Black, the defender, but it is impossible to prove that White has not moved his Rook.

PROBLEMS.

No. 10.

"Possibilities."

BLACK (8).



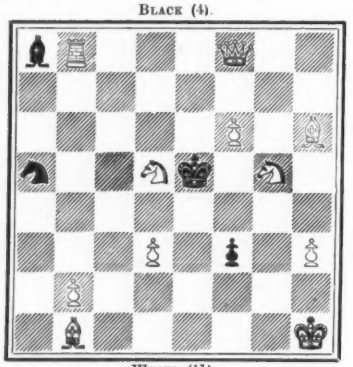
WHITE (6).

White mates in three moves.

No. 11.

"With how much labour wast thou wrought."

BLACK (4).



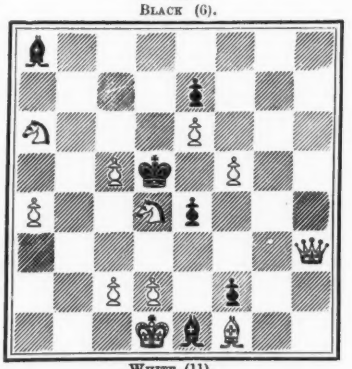
WHITE (11)

White mates in three moves.

No. 12.

"Ariadne."

BLACK (6).



WHITE (11).

White mates in three moves.

Note on Problem No. 6.—Mr. B. G. Laws, to whom we appealed on the question of dual short mates, gave as his opinion that they could not score. As Dr. Hunt, whom we asked for a final decision, was of the same opinion, which we have no doubt is correct, the point added temporarily to Mr. Johnston's score must be deducted. The following are therefore, at present, the seven leading scores:—

W. Jay	45
W. Nash	42
"Looker-on"	41
C. Johnston	40
J. W. Dawson	38
G. W. Middleton, G. Woodcock ...	37

CHESS INTELLIGENCE.

A return match by correspondence between the North and South of England will begin on October 1st, and conclude on June 1st. The teams on this occasion will be 100 aside, instead of 50, as in the last match. Players who wish to compete should write as soon as possible, if eligible for the North, to Mr I. M. Brown, 6 Wellington Place, Eccleshill, Bradford. If eligible for the South, to Dr. Hunt, 93, Richmond Road, Dalston, N.E. The qualifications are birth, or *bonâ fide* residence for the past twelve months. There will be a time limit of 48 hours, exclusive of Sundays and Bank Holidays.

The International Tourney at Hanover is beginning as we go to press. The competitors are limited to 18, and an unusually strong entry is probable, though Messrs. Lasker and Tarrasch will be absent. Herr Schlechter has recently defeated M. Janowski rather easily in a match at Carlsbad.

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